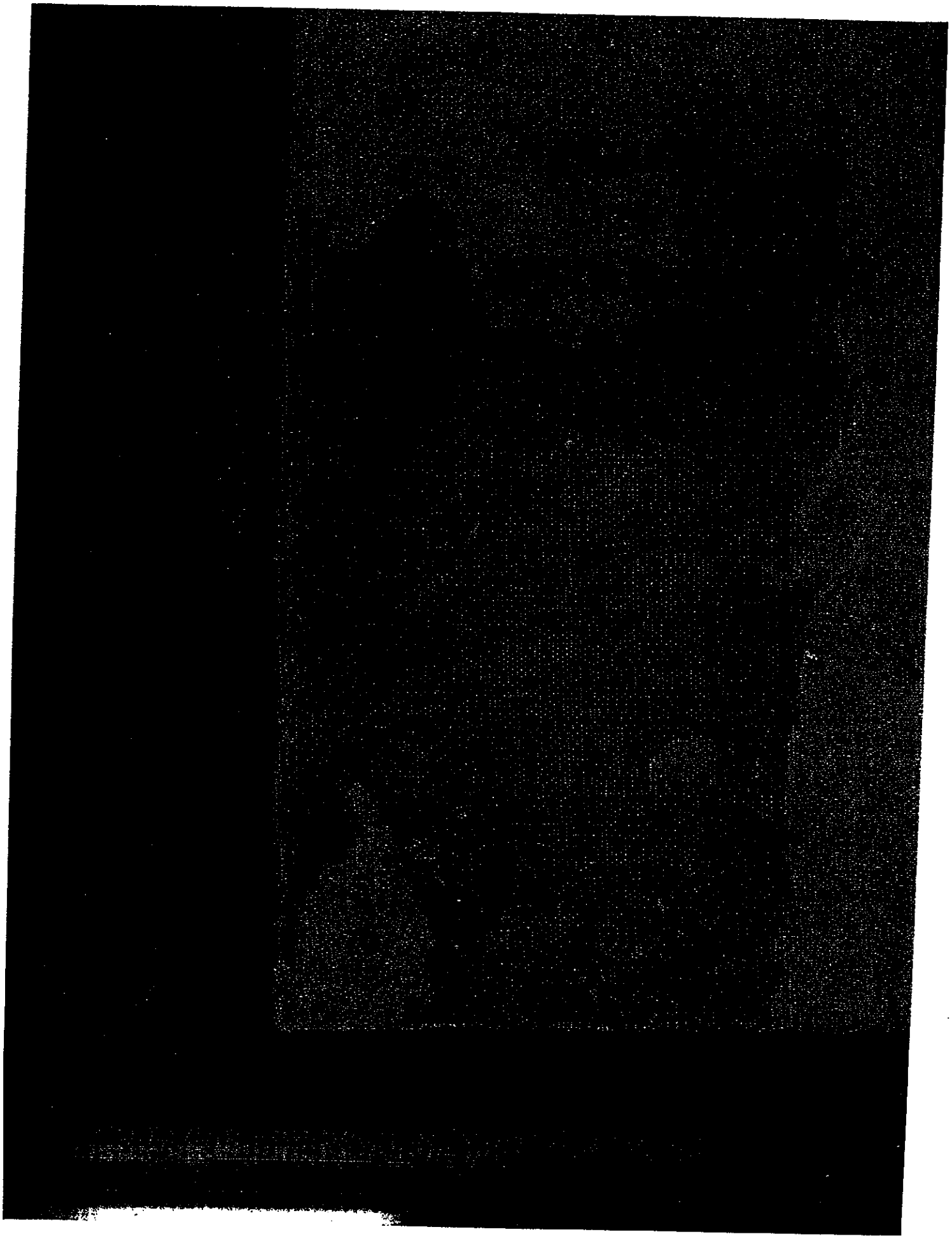

Exhibit 8

UNITED STATES NAVY DEPARTMENT
BUREAU OF MEDICINE AND SURGERY

ANNUAL REPORT OF THE SURGEON GENERAL, U. S. NAVY

CHIEF OF THE BUREAU OF MEDICINE AND SURGERY

TO THE SECRETARY OF THE NAVY

CONCERNING

STATISTICS OF DISEASES AND INJURIES IN THE UNITED STATES NAVY

FOR THE CALENDAR YEAR

1939

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1941

DEFENDENT'S
EXHIBIT
Buffalo Pumps
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ious action of the light.

INDUSTRIAL MEDICINE

Navy Yard, Charleston, S. C.--In order that claims for industrial injury may be confined to those receiving such injury by reason of their employment in the navy yard, all applicants for trades listed as potentially hazardous, receive a special examination, including X-ray examination of chest, where necessary, prior to their employment or assignment to the hazardous occupation. In addition to the entrance examination, periodical examinations are given during continuance of occupation in such work. This increases the work of the Yard dispensary and involves considerable additional cost to the government by reason of materials expended, but it is believed that the results obtained will prevent any serious industrial injury to the man occupied in hazardous industrial trades and prevent unjust compensation claims to be filed against the Government. As a means of protection to fellow employees and to prevent unjust claims to compensation for injuries alleged to have been received by reason of industrial employment, it is recommended that as a condition of employment all Civil Service applicants be required to have a serological test, with the provision that applicants who show a positive serological reaction but no active lesions, shall be required to have continuous medical treatment until negative serological tests are obtained or the disease is pronounced non-infectious by the Yard medical officer. It is also recommended that where infection occurs subsequent to employment that serological tests be made compulsory: As condition of employment, large private industrial corporations require serological tests prior to employment and at periodic intervals thereafter. If it is found that employees have active syphilitic disease, medical treatment is compulsory unless they are pronounced non-infectious by the company physician. Medical treatment for Civil Service employees could be obtained from private physicians or public clinics, and such treatment could be evidenced by certificates signed by licensed practitioners, but serological examinations should be performed at the Yard dispensary in order that a uniform procedure may be followed.

Puget Sound Navy Yard, Bremerton, Wash.--The average employee of this Navy Yard is safety-minded, and a general spirit of cooperation with regard to accident prevention continues. The safety program has been carried forward with excellent results during the past year, emphasis being placed on education of men through indoctrination of the supervisors. Analysis of representative periods have shown that approximately 90 percent of all accidents are directly attributable to carelessness of the men. The record of 18 lost-time accidents among 5,985 employees as compared with 22 lost-time accidents among 4,022 employees in 1938 is considered very satisfactory.

During the past year the following additional safety measures have been undertaken: (a) a new type of face shield has been obtained for buffing and polishing work which is a great improvement over goggles; (b) new double lenses for helmets have been obtained which are found to be much more satisfactory than the old; (c) salt tablet dispensers have been installed in all shops in which "hot work" is carried on; (d) ventilation of shops and offices has been materially improved, and is continuing to improve as funds become available for projected work; (e) an investigation has shown that men on machine tool work wearing corrective spectacles have only one-eighth the number of eddec particle eye injuries as compared to men wearing no spectacles. Ordinary cup goggles are unsuitable for most types of machine tool work due to restricted vision. It has been proposed to the Navy Department Safety Engineer that a suitable type of spectacle goggle without side pieces be approved for use on these types of machine tool work; and (f) the present Navy specification welding glove has been found to be unsatisfactory, particularly for overhead electric welding. A number of men have been burned due to failure of exposed stitching in this glove. It has been proposed that a more suitable type of glove be approved.

The number of eye injuries among the regular Yard employees was more than double for the calendar year 1938 - 223 for 1938 and 457 for 1939. The increased number of employees can account for some of the increase but the eye injuries have increased out of proportion. Outstanding causes of injuries to the eyes have been poor fitting goggles and failure to use goggles in spite of educational activities on the part of the medical department, injury officer, and supervisors. It is gratifying to note that there were no lost-time eye injuries among the regular Yard force and only one case among the relief workers.

Statistics show a definite increase in all types of injuries among classes of employees except the Emergency Relief, Navy. This increase is out of proportion to the increased personnel and it is believed to be due to the fact that the shop superintendents insist that employees receiving injuries, no matter how slight or insignificant they may seem in extent or severity, report to the Dispensary for treatment. This opinion is supported by the reduction in the actual number of "Injuries resulting in Loss of Time" from 22 during 1938 to 18 during 1939.

Navy Yard, New York, N. Y.--Welding: There are approximately 450 electric welders and 112 gas welders carried on the rolls.

It is well recognized that in the absence of protective measures or with inadequate measures welding incurs certain health hazards, such as toxic gases from the arc of the flame, fumes or dust of metallic oxides of an injurious nature from the coating of certain welding rods, damage to the eyes from ultraviolet rays, etc. The question arises whether or not control protective methods now provided are entirely adequate to prevent occupational diseases in welders under all circumstances.

It was recommended to the Commandant in December 1939, at the suggestion of the Director of the Division of Industrial Hygiene, New York State Department of Labor, that a joint health study of the 930 electric, gas, and tack welders, be conducted by the latter agency and the medical officer of the Yard. The proposed research contemplated medical and occupational histories, physical examinations, and X-ray studies, the funds and bulk of the research staff to be supplied by the New York State Division of Industrial Hygiene.

It was believed that such a study would yield results of great benefit to the workers and that the findings would be significant as a check upon the present methods of control and of value to the U. S. Employees Compensation Commission in relation to certain possible future compensation claims. Other outstanding authorities in industrial hygiene were consulted and all concurred in the view that a large-scale health study of welders was required to settle definitely certain questions relative to hazards of the occupation.

Lead and Lead Compounds: There is little hazard incident to brush painting in this Yard. Lead paint is used chiefly for the red lead priming coat for the hulls of ships. Zinc, titanium or aluminum paints are largely used for other applications. The enamel paint consist of a zinc base in varnish and turpentine. No cases of lead poisoning have come to the attention of the Medical Department during the period un-

der consideration. Metallic lead is handled in the molten state as a component of Babbitt metal in the Inside Machine Shop (No. 31). This metal contains lead, antimony, and copper. The lead volatilizes at a relatively low temperature. The melting kettles are equipped with a hood connected to an air exhaust system with suitable suction fan pipe and conduit to remove fumes which form on the surface of the molten metal. In addition, a respirator is provided for protection against the inhalation of fumes.

Lacquer painting with spray technique is conducted with lacquers made up of a celluloid base with certain volatile solvents, some fast and some slow drying, which may lead to toxic symptoms if inhaled beyond threshold concentrations.

The Ordnance Machine Shop, Electrical Shop, and Sheet Metal Shop are equipped with hoods connected to adequate exhaust systems. In the Ordnance Machine and Sheet Metal Shops a water spray curtain is also provided for more effective removal of fumes. The spray room of the paint shop is not equipped with a hood, dependence being placed upon an exhaust blower for removal of fumes. This lack of localized exhaust results in a much slower rate of removal of contaminated air. No cases of volatile solvent poisoning were reported during the calendar year.

It is recommended that all spray painters be given an annual examination for evidence of toxic effects of volatile solvents.

Industrial Protection Against X-ray and Radium: (a) X-ray protection.--The Pipefitter Shop is equipped with one portable X-ray machine of 220 kilovolts and 25 milliamperes capacity which was installed approximately two years ago. This is employed chiefly for the detection of flaws in pipe-welded joints for high steam pressure installation. The maximum number of exposures approximates a total of 51 minutes a day. (1) Engineering Control: The X-ray tube is encased in lead of 2mm. thickness. The machine is contained in an enclosure 20 feet by 20 feet bounded by a shield 6-1/2 feet high, 10 feet from the tube in all directions and lined with sheet lead 2mm. thickness on three sides. (2) Medical Control: Four men are assigned as operators of the X-ray and radium installations. One of the earliest effects of radiation exposure is a destructive action on the white and red cells of the blood, more marked on the white cells in the early stages. A procedure has been established for a quarterly blood examination of operating personnel and an examination for possible general radiation injury.

(b) Radium Protection.--The use of radium was initiated 4 to 5 years ago for the detection of flaws in castings constructed for high pressure steam installations, both steel and non-ferrous. A capsule containing 278 mgms. of radium is the source of the radiation, the tests being conducted in the Inside Machine Shop. This is in use for an average of 150 to 200 hours a month. The chief metallurgist reports that high speed films exposed at a distance of 12 feet from the capsule for one hour showed no fogging. It is therefore concluded that employees are not subject to harmful radiation at that distance. Protective measures appear adequate.

It is emphasized that a thorough physical examination of a radium or X-ray worker shall be made before he is employed and at any time that the blood count shows suggestive changes or the worker complains of an obscure ailment. The question arises whether the foregoing measures of protection against X-ray radiation are entirely adequate. The situation was recently discussed with the Chairman of the Advisory Committee on X-ray Protection of the Bureau of Standards. It was suggested that personnel within the distance of 40 feet external of the lead

workers would probably not receive a damaging exposure, the question of such a possibility demands consideration. The absolute necessity for further protection can be definitely determined by actual measurements of scattered radiation by means of the portable ionization chamber. It is recommended that the advisability of such tests be considered.

Precautions Relative to Pickling of Metals: (a) Building Ways, No. 1.--There are two sets of pickling tanks in this area one for flat steel and one for piping. The acid employed is dilute sulphuric. The question at issue is whether at any stage of operation personnel are subjected to the inhalation of arsine gas or arsenic dust originating as a result of contact with arsenic, present as an impurity of the metal, with nascent hydrogen in the bath. Such a possibility appears extremely remote in view of the fact that the operations are conducted in the open air thus excluding the possibility of rising accumulation of arsenical compounds which might result in an enclosed space. However, it is advisable that the operating personnel be examined semi-annually for possible evidence of arsenic absorption instead of the quarterly examination now prescribed.

(b) Coppersmith Shop.--Both sulphuric and muriatic acids are used in the vats of this enclosed space connected with the coppersmith shop. The possibility of arsenical exposure discussed above also obtains for this space. Forced exhaust ventilation is provided and appears adequate. A semi-annual medical examination of operating personnel is advisable.

Occupational Dust Hazards: (a) The Steel and Brass Foundries.--The chief hazard to be considered is silicosis due to the inhalation of silica dust, the extent of the hazard being dependent upon the concentration, size of the particles, percentage of free silica, and the duration of exposure. Whether or not a silicosis hazard exists in these foundries can only be determined by actual counts of dust particles concentration under the various working conditions and the estimation of free silica in the sand used. It has recently been reported by the New York State Department of Labor that silicosis can be prevented if the average plant concentration does not exceed 15 million parts per cubic foot.

(b) Casting Cleaning Shop.--The conditions in this shop appear to be particularly unfavorable. The iron and brass foundry buildings are equipped with forced exhaust ventilation although its efficiency in controlling dust concentrations is undetermined. The casting cleaning shop, however, is not provided with any mechanical ventilation, dependence being placed mainly on roof cowls, which, it is believed, are inadequate.

Certain of the grinding and chipping operations should be conducted under hoods with localized suction ventilation. Two high-speed emery wheels and two carborundum grinding wheels are not equipped with suction ventilation. It is recommended that consideration be given to a systematic engineering survey of both foundries and the casting cleaning shop to include dust counts and the measures necessary to reduce silicosis hazards.

There are 33 employees in the iron foundry, 64 in the brass foundry, and 22 in the casting cleaning shop. It would be desirable to carry out a medical survey, including X-ray of the lungs, of all personnel in order to determine the incidence of silicosis. For the present, however, it is suggested that such a study be limited to employees in the casting cleaning shop where the worst conditions prevail.

All candidates for employment for foundry oper is should be given an X-ray examination of the lungs in order to scre out cases in

any state of silicosis.

(c) Sandblasters.--The present practice of an annual X-ray examination of the chest, or oftener if so indicated, will be continued.

(d) Hazard of Buffing and Polishing.--The possible hazard incident to dust from artificial abrasives such as carborundum, alundum, and emery should be considered. The dust from these materials does not contain free silica and therefore will not produce silicosis. However, if breathed for protracted periods, these dusts induce an X-ray appearance similar to that of early silicosis. This picture changes very slightly as length of exposure increases. There is clinical evidence, however, that workers exposed to heavy concentrations of abrasive dust are more susceptible to diseases of the chest than those not so exposed. Authorities in this field advise that an effort should be made to keep the dust count below 20 million particles per cubic foot. The dust is approximately 50 percent abrasive and 50 percent metallic. Although respirators are provided for individual use, it is impracticable to wear such a device constantly.

The buffing and polishing wheels in the Sheet Metal Shop are not equipped with localized exhaust. This is recommended as a safety precaution.

The grinding wheels in the tool room of the Shipfitter Shop are provided with either individual exhaust or are kept constantly wet which reduces to a marked degree the quantity of escaping dust.

Hazard of Asbestosis: Asbestosis is an industrial disease of the lungs incident to the inhalation of asbestos dust for prolonged periods, and is distinct from silicosis. The development of the disease depends upon the concentration of the dust, the size of the dust particles, and the length of exposure. The workers in the Pipe Covering and Insulating Shop are exposed to the inhalation of asbestos dust incident to the cutting of asbestos insulating felt in the fabrication of covers for flanges, valve bonnets, and high temperature steam turbines. The material falls under the trade name of "Amosite."

A medical survey of the 11 employees in this Shop was conducted recently with the object of ascertaining whether asbestosis in any stage could be detected. The history of exposure varied from 1.7 to 17 years, 6 men reporting 10 years or over. Present and past disability attributable to asbestosis was denied by all the men and X-rays of the chest were essentially negative in all cases. However, it was not considered that the negative findings precluded the future development of asbestosis by continued exposure to present occupational conditions. The following recommendation made jointly by the medical officer of the Yard and the safety engineer was approved: Install an exhaust blower over work table in the Pipe Covering and Insulating Shop to remove asbestos dust at the source as a protective measure against the hazard of asbestosis.

Norfolk Navy Yard, Portsmouth, Va.--Considerable work has been accomplished in industrial medicine. The medical officer, safety engineer, and W. P. A. Safety Supervisor work in close consultation. In this manner the medical and technical aspects of each industrial problem is properly coordinated. The Bureau of Medicine and Surgery and the Navy Department Safety Engineer have been consulted on several occasions and have given valuable suggestions.

A special effort has been made to collect literature and data with regard to industrial medicine to be used for reference purposes. Special attention is given to the working conditions in hazardous occupations such as sand-blasting, asbestos pipe-covering, amosite [illegible] fiberglass insulation. Ventilation, clothing, masks, etc. are cl[illegible]ed frequently. Routine inspections have revealed that helmets used in [illegible] blasting are of various types. A special study is being attempted with regard to types of masks, helmets, and respirators with the idea of recommending standard items of as near one type as possible.

An extensive study of a new insulating material, fiber-glass, now employed by the Navy, has recently been carried out by this department. Representatives of the manufacturers of this product have been interviewed, and numerous reports of clinical and laboratory investigations have been reviewed. The representatives claim that no harmful effects from the material have been noted among their employees over a period of 6 years, and the only precautions used are loose clothing and a good cleansing shower at the end of each working day. The evidence submitted is not entirely convincing, and the period of time since the introduction of the product is too short to warrant any definite conclusions at present. Until further information is available the following precautions are in effect: The employee must wear hood, respirator, and gloves at all times; the clothing must be loose and cover the arms and neck; goggles must be worn if there is excessive circulation in the compartment; and showers are required before lunch and at the close of the day.

At present the Norfolk Navy Yard has no instruments for making dust counts. The acquisition of at least one of the new and recently improved instruments would be a great advancement in the field of industrial medicine at this Navy Yard and would afford an opportunity for considerable research.

The hazards to civil employees consequent to industrial activity is a problem and requires continued, intense, effort and research with regard to personnel, new materials, new machinery, and new processes. Safety devices and rules should maintain a high standard. This aspect should be studied, developed, and mastered. It requires cooperation in safety engineering and intensive study of industrial health problems.

Naval Torpedo Station, Newport, R. I.--The number of infections following injuries remains low among civil employees at this station. This is due no doubt to the cooperation of all concerned in routing injuries, no matter how trivial, to the dispensary, where they are promptly treated. A follow-up system is also used whereby cases must report for daily observation and redressings until discharged. Many cases of colds, grippe, and bronchitis have developed among the civilian employees during the fall and winter months. By treating these cases three times daily with antiseptic sprays, cough mixtures, and cold capsules, and the prompt checking out of cases with elevated temperatures, an appreciable decline in lost-time incidence has been noted. It is encouraging to note that accidents are on the decline in spite of the increase in employees. By comparative classification we find that in 1935 there were about 4,962 injuries among 2,493 employees and in 1939 about 3,500 injuries among 3,852 employees.

A general physical examination of all workers in explosive materials, including a complete blood analysis and urinalysis, has been done monthly since October, 1939. An effort is being made to prevent occupational poisonings, with particular reference to tetryl and fulminate of mercury. To date no statistical data have been completed. Sand-blasters are examined routinely each month, and routine chest X-rays are done every three months, oftener if thought necessary.

Diseases of Class XV, by occupational groups, new admissions, 1939

Occupational group	Psychoneuroses (All)		Constitutional psychopathic inferiority, without psychosis		Constitutional psychopathic state, etc. (all)*		Dementia praecox		Psychosis intoxication, alcoholic		Psychosis, unclassified		Psychosis, manic depressive**		Miscellaneous	
	Order of frequency	Rate per 100,000	Order of frequency	Rate per 100,000	Order of frequency	Rate per 100,000	Order of frequency	Rate per 100,000	Order of frequency	Rate per 100,000	Order of frequency	Rate per 100,000	Order of frequency	Rate per 100,000	Order of frequency	Rate per 100,000
Officers of the Navy and Marine Corps	7	150.58	----	----	----	----	----	----	----	----	6	22.59	4	7.53	6	15.06
Midshipmen	15	45.23	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Electricians	13	111.59	----	----	5	44.54	10	22.32	----	----	----	----	3	11.16	----	----
Engine-room force	8	143.94	----	----	9	11.99	8	35.98	2	11.99	----	----	----	----	7	11.99
Fireroom force	9	141.58	1	30.78	6	30.78	6	80.02	----	----	4	24.62	----	----	6	12.31
Miscellaneous artificers	11	124.60	----	----	----	----	1	124.60	----	----	----	----	----	----	----	----
Clerical force	3	201.48	----	----	----	----	7	44.77	----	----	6	22.39	----	----	3	44.77
Culinary force	10	139.61	2	12.69	2	101.64	2	114.23	----	----	7	12.69	1	25.38	----	----
Hospital Corps	2	319.78	----	----	4	45.68	4	91.37	----	----	----	----	2	22.84	----	----
Marines	6	156.66	3	10.80	3	59.42	3	102.64	3	10.80	3	37.81	5	5.40	2	48.62
Musicians	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Prisoners	----	----	----	----	1	471.70	----	----	----	----	----	----	----	----	----	----
Nurses (female)	1	456.62	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Aviation artificers	4	173.58	----	----	8	17.36	9	34.72	----	----	1	52.07	----	----	----	----
Apprentice seamen	14	89.23	----	----	----	----	11	14.87	----	----	----	----	----	----	1	74.36
Ordnance ratings	5	166.32	----	----	----	----	----	----	1	20.79	2	41.58	----	----	----	----
Seaman, other than apprentice seamen	12	112.79	4	7.20	7	28.40	5	81.59	4	4.80	8	7.20	6	4.80	4	19.20

*Includes "Emotional Instability"
**Includes "Hypochondriasis"

RESPIRATORY SYSTEM

There were 318 original admissions and 20,719 sick days for diseases in this class during the year 1939, accounting for 0.52 percent of all admissions and 1.72 percent of total sick days.

In addition, there were 54 admissions for complications of other diseases or conditions, 21 admissions reported as existing prior to enlistment, 74 readmissions, and 47 cases remaining from the previous year.

Four of the diagnoses in Class XVIII (chronic bronchitis, asthma, acute fibrinous pleurisy, and sero-fibrinous pleurisy) caused 75 percent of class admissions and 68 percent of class sick days.

The common acute infectious diseases of the respiratory tract, colds, acute bronchitis, etc., as well as pneumonia, are classified as "Communicable diseases transmissible by oral and nasal discharges," and certain other diseases that might be thought of as diseases of the respiratory system, are accounted for in Class V, "Diseases of ear, nose, and throat." Class XVIII, therefore, does not account for a great number of admissions to the sick list.

Diseases in this class causing more than 10 admissions, together with a total for those diseases in the class causing less than 10 admissions, are listed in the following table:

Diseases of Class XVIII, admissions and sick days, 1939

Disease	New admissions	Admission rate per 100,000	Sick days per case
Bronchitis, chronic	85	57	32.1
Asthma	64	38	39.2
Pleurisy, fibrinous, acute	52	35	18.5
Pleurisy, serofibrinous	46	31	64.3
Pneumonitis, acute	24	16	27.5
Total for diseases in the class causing less than 10 admissions	57	38	51.9
Total for entire class	318	213	40.3

Diseases of Class XVIII, with complications, 1939

Disease	Number cases admitted	Complication	Cases	Percent
Bronchitis, chronic	91	Pleurisy, serofibrinous	1	1.10
Asthma	69	Poisoning, therapeutic, acute, bichloride of mercury	1	1.45
Pleurisy, fibrinous, acute	53	Pleurisy, fibrinous, chronic	4	7.55
		Pneumonitis, acute	1	1.89
		Pneumonia, lobar, Type VIII	1	1.89
		Pyelonephritis	1	1.89
Pleurisy, serofibrinous	53	Pleurisy, suppurative	3	5.66
		Pleurisy, fibrinous, chronic	1	1.89
Pneumonitis, acute	39	Pneumonitis, chronic, nontuberculous	1	2.56
Pleurisy, fibrinous, chronic	15	Bronchiectasis	1	6.67
Pleurisy, suppurative	11	Abscess, brain	2	18.18
		Pleurisy, fibrinous, chronic	1	9.09
		Sinus, thoraco-axillary	1	9.09
Pneumothorax	10	Pleurisy, fibrinous, chronic	1	10.00
		Pleurisy, serofibrinous	1	10.00
Pneumonitis, chronic, nontuberculous	6	Pneumonia, chronic, interstitial	1	16.67

Diseases of Class XVIII, classifled personnel, admissions by age group, 1939

Age group	Officers, Navy and Marine			Enlisted men, Navy			Enlisted men, Marine		
	Number in group	New admissions	Rate per 1,000	Number in group	New admissions	Rate per 1,000	Number in group	New admissions	Rate per 1,000
16 to 19	0	0	0	11,810	30	2.54	3,802	3	0.79
20 to 24	1,130	1	0.88	50,129	99	1.97	8,362	23	2.75
25 to 29	2,400	10	4.17	22,580	39	1.73	2,813	6	2.13
30 to 34	2,226	3	1.35	14,880	27	1.81	1,880	4	2.13
35 to 39	2,368	6	2.53	11,375	22	1.93	1,206	3	2.49
40 to 44	1,881	6	3.19	2,923	8	2.74	526	2	3.79
45 to 49	1,494	6	4.02	630	6	9.52	261	2	7.66
50 to 54	1,057	2	1.89	182	1	5.17	93	0	0
55 to 59	540	0	0	22	0	0	23	1	43.48
60 to 64	183	1	5.46	4	0	0	3	0	0
65 and over	3	0	0	0	2	0	0	0	0
All ages	13,282	35	2.64	114,527	232	2.03	18,951	44	2.32

CIRCULATORY SYSTEM.

Diseases in this class were responsible for 562 original admissions and 40,522 sick days, or 0.92 percent of all admissions and 3.37 percent of total sick days. The admission rate was 376 per 100,000, as compared with 326, the admission rate in 1938, and 356, the median for the 9 preceding years.

Five of the diagnoses in the class (arterial hypertension; varicose veins; thrombosis, coronary artery; phlebitis; and chronic myocarditis) caused 61 percent of class admissions and 63 percent of class sick days.

In addition to the 562 original admissions shown in the table below, there were 51 admissions covering cases reported as complications of other diseases and conditions, 116 readmissions, 85 for diseases reported as existing prior to enlistment, and 107 cases remaining from the previous year.

Thirty-five of the 105 persons invalided from the service on account of diseases in this class incurred the disability prior to entering the service.

Diseases for which 10 or more admissions were recorded during the year and a total for those diseases in the class causing less than 10 admissions are shown in the following table:

Diseases of Class II, admissions and sick days, 1939

Disease	New admissions	Admission rate per 100,000	Sick days per case
Hypertension, arterial	162	108	44.7
Varicose veins	79	52	28.0
Thrombosis, coronary artery	38	25	76.7
Phlebitis	32	21	42.9
Myocarditis, chronic	30	20	60.4
Cardiac arrhythmia, premature contractions	23	15	40.3
Syncope	21	14	20.8
Epistaxis	17	11	6.6
Arteriosclerosis, general	16	11	45.1
Tachycardia	16	11	31.0
Coronary heart disease, arteriosclerotic	13	9	59.3
Angioneurotic edema	12	8	19.8
Cardiac disorder, functional	12	8	20.1
Cardiac arrhythmia, paroxysmal tachycardia	10	7	28.3
Total for diseases in the class causing less than 10 admissions	81	54	52.1
Total for entire class	562	376	44.0

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UNITED STATES NAVY DEPARTMENT
BUREAU OF MEDICINE AND SURGERY

ANNUAL REPORT OF THE SURGEON GENERAL, U.S. NAVY

CHIEF OF THE BUREAU OF MEDICINE AND SURGERY

TO THE SECRETARY OF THE NAVY

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UNITED STATES
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WASHINGTON · 1944

and reclaiming unit. The decrease in the concentration of dust has been of primary importance from the health standpoint. Other advantages are a decrease in operating cost because of ability to reclaim some 75 percent of the sand and water, decrease in time needed for cleaning castings, better quality of the finished job, and elimination of pickling process to get rid of last traces of sand.

Navy Yard, New York, N. Y.—Experience indicates that individuals of the type to apply for employment through the Labor Board have an incidence of active pulmonary tuberculosis of about 2 percent. In most cases, the disease cannot be detected by ordinary physical examination. Consideration is at present being given to the practicability of including a chest x-ray as part of the preemployment examination.

The urgent demand for personnel, particularly in some of the skilled trades, has led to a lowering of the physical standards set forth by the Civil Service Commission in a number of occupational classifications. Up to the present time, there has been no evidence that this lowering of physical requirements has been responsible for increased illness or accident rates.

In accordance with instructions contained in Secretary of the Navy letter dated 25 October 1941 periodic physical examinations have been given to employees engaged in certain work hazardous to themselves or others. In addition to these periodic examinations, it has been considered advisable to perform periodic chest x-ray examinations on tool-grinders and on workers handling fibre glass. The use of this latter material has recently been introduced for insulating purposes, and since little is known of the effects of fibre glass dust upon the lungs, it seems desirable to keep a close watch of those employees who handle this material. In view of the increased scope of the periodic examinations, expansion of the facilities for performing these examinations has been necessary. The establishment of an industrial health office has been the first step to meet the increased requirements of the industrial program. It was felt that improved x-ray equipment suitable for taking chest x-ray films would facilitate and expedite performance of the required periodic examinations. Purchase of such equipment has been approved.

In July 1941, a Reserve officer with a wide experience in industrial health work was assigned to duty at the yard. Shortly thereafter, a medical officer from the Regular Navy who had undergone a course of training in industrial hygiene, was ordered to duty at the yard. After a short period of indoctrination, these two officers were designated as Industrial Health Officer and Assistant Industrial Health Officer, respectively.

A comprehensive industrial health program has been put into operation. The following activities have already been accomplished:

(*a*) Survey of lighting in several shops with recommendations for improvement.

(*b*) Study of the efficiency of spray painting booths, with recommendations.

(*c*) Study of ventilation in the temporary foundry, with recommendations.

(*d*) A study of illness (mercury poisoning) among painters working with antifouling plastic paint. As a result of this study, effective control measures have been put into effect.

(*e*) An investigation of nonstandard cleaning and degreasing agents used in the yard. As a result of the findings an order was issued prohibiting the use of unapproved cleaning agents in the yard.

(*f*) Compilation of a list of materials used in the yard which may offer potential health hazards. This list includes all solvents, such as benzol and carbon tetrachloride; all dust-producting materials, such as asbestos, sand, and fibre glass; and all toxic metals, such as lead and magnesium. Tabulations have been made showing which shops are using each substance and a paralleled analysis showing what materials are used in each shop. These tabulations are to be used as a basis for a comprehensive program of occupational disease prevention.

(*g*) A campaign of health education was instituted in an effort to reduce lost time due to nonindustrial illness among civilian employees. Posters illustrating the spread of respiratory infections have been placed on all bulletin boards in the yard. Plans have been formulated for distributing educational material on the subject of colds, tuberculosis, and nutrition.

(*h*) Preemployment chest x-ray survey. During the latter part of 1941, plans were completed for taking chest x-ray films on a sample of 1,000 consecutive male applicants for employment to ascertain whether any significant number of cases of active pulmonary tuberculosis will be found among men seeking employment at the yard.

(*i*) Space on the ground floor of Building No. 200, at the present time occupied by the safety engineer, has been allocated for use as industrial health office and laboratory.

Norfolk Navy Yard, Portsmouth, Va.—Although some attention has been directed to industrial hygiene at this yard for several years, it was not until the latter part of 1941 that a medical officer was assigned to this phase of medical department activities. The safety officer and the medical department have cooperated in an effort to detect hazards, and recommend measures to obviate them or make them less hazardous.

Preemployment physical examinations were conducted by the medical section of the Labor Board. An attempt is being made to conduct recheck examinations as recommended by the Navy Department, especially on those engaged in occupations involving hazardous exposures. Complete blood counts were obtained on lum handlers, basophilic aggregation tests on welders, cutter

burners, and painters, and x-ray examinations of the chest are made on sandblasters.

The silica hazard in the foundry was reduced somewhat by the substitution of steel grit for sand in two modern blasting units. One old type sandblasting unit using sand is still in operation. Plans to replace this unit have been made and it is anticipated that this will be accomplished as soon as practicable. To minimize the hazard presented by sandblasting operations, approved personal protection equipment is provided.

There has been some time loss from metal fume fever, particularly among those working around welding and burning operations on new construction and repair jobs. In many cases the men are exposed unnecessarily to fumes due to reluctance on the part of leading men to take the time to secure and set up blowers in compartments where they are needed. It very frequently happens that attacks of metal fume fever develop among others working in the compartment than in welders or burners. Also cases develop among those working in a compartment when the bulkhead is being heated on the opposite side. This necessitates adequate ventilation in both compartments. An approved metal fume respirator that is so constructed that it can be worn under a welder's shield is being recommended for use by those exposed to metal fumes, and it is anticipated that the use of these respirators will reduce the time loss and increase production and efficiency.

There continues to occur an unnecessary number of cases of ophthalmia due to actinic rays from the welding arc. This is due to inexperience among many of the welders' helpers, carelessness on the part of those that may be working near welding operations, and failure of the welder in many instances to shield his work properly.

Goggles are provided for and generally used by those engaged in chipping and grinding. In spite of this an average of five foreign bodies in the eye occurs each day. These are most frequently due, however, to causes other than grinding and chipping. Occasionally a foreign body in the eye case is due to improperly fitting goggles as well as goggles worn on the forehead instead of over the eyes, and many of them happen while the worker is walking about in the yard to and from jobs and to and from work.

The campaign for the wearing of safety shoes has not been successful, and there continues to be an undue number of toe injuries, particularly among riggers.

Puget Sound Navy Yard, Bremerton, Wash.—A medical officer reported 11 August 1941 as the industrial medical officer for this navy yard. He is doing excellent work, and has offered many suggestions that have been instituted in aiding the health and hygiene of the industrial yard.

The list of technical equipment to establish an industrial health laboratory has been approved.

The industrial health officer is working in close cooperation with the injury officer and the leading-men of the various shops projects. Some very interesting and informative data ha[ve]

been accumulated regarding injuries to yard employees and nonoccupational lost time.

The enlarged industrial health program was explained to the heads of the departments in the yard and to the masters of the various shops. The new program was received with enthusiasm and assured full cooperation. Many contacts with quartermen, leadingmen and individual workers have been established by the industrial medical officer during his frequent visits to the shops. A survey was made of all the shops and activities, and a chart prepared showing the location and nature of the possible health hazards.

Space for an industrial hygiene laboratory has been allotted in the chemical laboratory building and technical equipment has been requested. With the establishment of this laboratory, facilities will be available for investigation of industrial health hazards in this naval district.

A total of 2,276 eye injuries were treated at the dispensary during 1941 which indicates that the present eye protection is not satisfactory. The fact that eye injuries totaled 25.5 percent of all cases, but accounted for only 3.2 percent of the lost-time accidents indicates that there were few complications following the injuries.

The industrial medical officer has been working in cooperation with the safety engineer to determine the basic causes of the high frequency of certain types of injuries in the various trades. Meetings of supervisors in classes of 40 to 50 have been initiated. At these meetings emphasis is placed on the responsibility of the supervisors in guarding the safety and health of their men. Numerous problems and comments about procedures, policies, equipment and conditions were uncovered in the discussions following these meetings.

There were 10,401 sick leave applications during the year requesting a total of 46,451 sick days. Since a few employees do not have sufficient accumulated sick leave to cover their entire illness or injury, some take annual leave instead of sick leave, and some of the sick leave applications are not approved, 46,451 is not the total days absent from work due to nonoccupational illness. The following summary of a 3-year period is submitted for comparison:

	1939	1940	1941
Number of sick leave applications	2,768	6,174	10,401
Number of sick days requested and approved	16,997	28,594	46,451
Average days requested per application	6.25	4.63	4.46
Average number of applications each month per 1,000 employees	46.1	66.6	62.1
Average number of sick days requested each month per 1,000 employees	282	318	277

The lower average days of illness per case in 1940 and 1941 is apparently due to a great increase in one and two-day absences.

Both the frequency of applications and the nur[mb]er of sick days requested show an expected seasonal variation

Exhibit 9

C55-ec

March 11, 1941.

MEMORANDUM FOR ADMIRAL McINTIRE:

Subject: Notes for consideration when you call on Assistant Secretary Bard.

1. We make specifically what the policy is concerning invitation of such people as Mr. Zimmer of the Bureau of Labor Standards, Labor Department into the Navy Yards to make a survey of the welding and other hazards. I told him that we had never done that sort of work and recommended against it, as I know who Mr. Zimmer intends to send in if it should be done.

2. My meeting with Mr. Bard was specifically due to the fact that Captain Fisher had written a letter to Dr. Selby inviting him to make a survey of Navy Yards, with particular reference to health hazards, and make recommendations to the Shore Establishments Division.

I gave Mr. Bard and the two officers present a complete story of the beginning of this controversy from the Federal Administrator's letter; that is, that the United States Public Health Service had four teams of traveling scientists alleged to be able to make surveys of all of the Navy Yards and make recommendations for the correction of such hazards as were discovered. I told Mr. Bard that this was not considered the best policy, due to the fact that we had medical officers in the Yards and that in practically all instances recommendations of sound character had been made by medical officers. We saw no need of inviting the United States Public Health Service on its own invitation to do this job.

3. Likewise, I told him that I had spoken to you and that you had indicated that President Roosevelt thought that this might not be the best policy, due to the fact that they might cause disturbance in the labor element.

4. Points of great interest:

(a) Such health hazards as silicosis in our foundries. None of our foundries would pass the necessary inspection to obtain workmen's compensation insurance from any of the insurance organizations. I doubt if any of our foundries would be tolerated if the State industrial health people were to make surveys of them. Repeated recommendations have been made by the medical officers attached to these Yards that studies be made on dust concentrations and steps be taken to remedy this condition.

DEFENDENT'S EXHIBIT Buffalo Pumps 24

(b) Sand blasting. Several recommendations have been made with reference to sand blasting and the danger from this hazard with particular reference to the production of silicosis. Since these recommendations have come in, we now are using steel shot rather than sand in sand blasting, but this is still a hazardous trade and might be restudied.

(c) Welding. Welding is a hazard under certain circumstances: that is, if nitrous fumes are encountered and these can be completely obviated by reasonable exhaust ventilation. However, several people have complained that we are doing welding under dangerous conditions. I frankly admitted that we had no data on which to make a considered opinion, but we would immediately start out with a view of determining the concentration of fumes of toxic metals or substances that might be in the welding rod.

(d) Solvents. Too little is known on the question of solvents and since there is a controversy between the toxicologists and industrial hygienists on this point, it will be necessary to do a very careful survey to determine whether we are in trouble.

(e) Hydrogenated hydrocarbons. This is a matter of considerable concern in industry and we may be getting damage from some of these, but no surveys have been made to tell us the concentration of these compounds.

(f) Eye flashes from unprotected electric arcs, such as welding and pouring. This can be completely obviated by using screens for the workmen.

(g) Cadmium dust, smoke and fumes. If we are doing as much cadmium welding as is indicated by unofficial information from the field, we may be in a position to be seriously criticized about this. This also needs research to determine the concentration.

(h) Chromium trioxide. Chromium plating is one of the dangerous occupations in that people frequently have perforated septum from irritation from chromium trioxide. Such plants as I have seen doing plating in the Navy appear to be fairly well ventilated, but there is evidence that a considerable number of people have been damaged from this hazard.

(i) Asbestosis. We are having a considerable amount of work done in asbestos and from my observations I am certain that we are not protecting the men as we should. This is a matter of official report from several of our Navy Yards.

5. We are not doing a very bad job of safety as we have won safety awards, but there will be a tremendous increase in the number of non-

fatal accidents, some of which will be lost time and some of which will be non-lost time, with the increase in personnel. This is already apparent from the reports from the Yards. If this is not enough to hold them down, I will give you all the additional information you need.

R. S. Stephenson,
Commander (MC), U. S. Navy,
In Charge, Div. of Preventive Medicine.

Exhibit 10

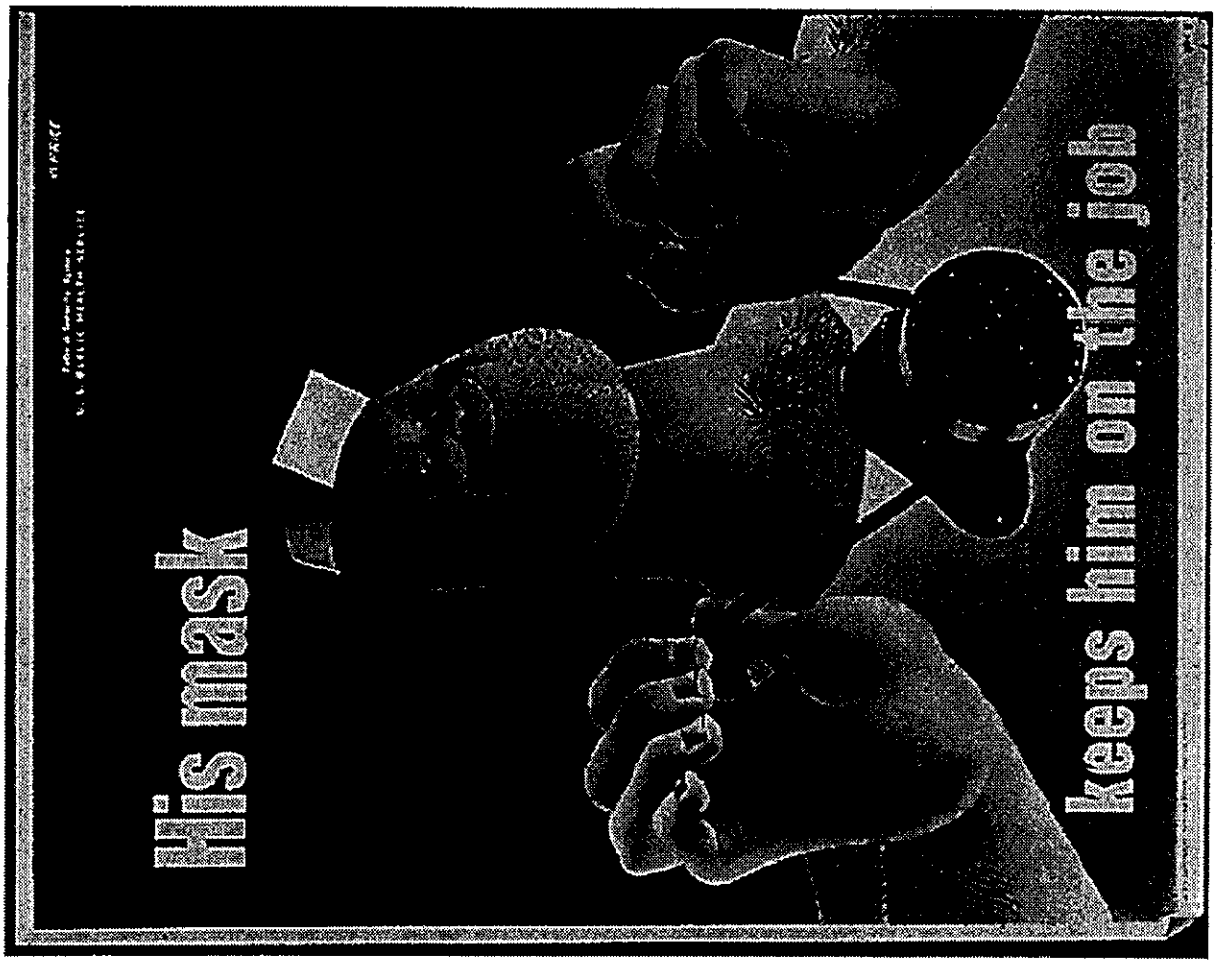
His mask
keeps him on the job

Exhibit 11

25, D. C.

January 31, 1945

Bureau of Medicine and Surgery
United States Navy Department
Washington, D. C.

Attention: Captain Thomas J. Carter, M.C.

2070325

Gentlemen:

Confirming our telephone conversation of the 30th, I enclose copy of report by Drs. Fleischer and Dreessen on the occurrence of asbestosis at Bath Iron Works, December 19, 1944, a series of dust counts by E. Ward Thompson of the insurance carrier, American Mutual of Boston and petrographic analyses of the dust by Dr. C. H. Williams, my own colleague at Harvard.

This evidence is enough to indicate a fairly serious dust risk at Bath and to make it very probable that the same sort of thing will be found in other plants and yards where the same type of pipe covering materials are used.

I met with the manufacturers of the materials used at Bath and they stated they would be glad to get out a brief statement of precautions which should be taken in the light of their own experience and that they would inform their competitors that I had asked them to do so. I understand that neither Navy nor Maritime wants any change in the specifications as the performance with the present materials is entirely satisfactory. From a health standpoint we do not believe any specification changes are needed.

I suggested to Admiral Mills that it would be very desirable for Navy to examine men handling the preparation of pipe coverings and their installation in at least two Navy Yards and two Navy contract yards as this is much more a Navy than a Maritime problem because the materials are used especially on Navy vessels with high pressure steam power plants. Admiral Mills agreed that such studies would be wise before Navy or Maritime accepted this asbestosis risk as being significant in our general ship construction program.

Therefore, could you not have such surveys made at Boston and New York Navy Yards? We could do two contract yards, preferably Bethlehem's Quincy Yard and either New York Shipbuilding or Federal.

DEFENDENT'S
EXHIBIT
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All four yards would be close together and we know that the two we might do would cooperate. I suggest we take dust counts and have Dr. Williams make the same sort of petrographic analyses unless your Bureau can do them. These petrographic studies would be the only items of expense for which neither your Bureau nor our office is prepared. Williams' charges would probably not exceed $150.00. If we had them done by an outside petrographer it would be at a rate of about $25.00 per sample.

Please let me have your thoughts on this matter and kindly send an extra copy to Lt. Commander W. E. Fleischer, Assistant Chief Health Consultant, United States Maritime Commission, Jefferson Building, 1015 Chestnut Street, Philadelphia 7, Pennsylvania.

Sincerely yours,

Philip Drinker
Chief Health Consultant
Division of Shipyard Labor Relations

Enclosure

PDrinker/drh

2070325

cc: Admiral Mills
Dr. Fleischer
Mr. Phillips G. Pearson
Mr. Daniel S. Ring
Div. Shipyard Labor Relations

Exhibit 12

9-21-45

A HEALTH SURVEY OF PIPE COVERING OPERATIONS IN CONSTRUCTING NAVAL VESSELS*

WALTER E. FLEISCHER,[1] FREDERICK J. VILES, JR.,[2] ROBERT L. GADE[3] AND PHILIP DRINKER[4]

AN INDUSTRIAL health inspection of an important U. S. Navy Contract Yard indicated that dustiness from miscellaneous pipe covering operations was considerable and that a few of the employees had what appeared to be asbestosis. This is a well-known industrial disease caused by only one thing—prolonged breathing of asbestos dust. The clinical manifestations are shortness of breath and an unusual chest picture by X-ray. In industry the disease is often disabling, but it is much less frequent than silicosis, with which it very properly is classed.

It was not felt that experience in a single yard was enough to justify any general statements on working conditions in other yards, and certainly was no cause for alarm, but the results warranted check-ups elsewhere. Accordingly, arrangements were made to examine by chest X-ray the pipe coverers in two Government Navy Yards, A and B, and in two Navy Contract Yards, C and D. Examinations were made of the working conditions including dust counts of the air breathed with microscopic and chemical analysis of the dust itself.

We would point out that this procedure is customary in making such surveys of occupational diseases—medical examination of the workers and a study of the nature and concentration of the contaminants in the air breathed.

PIPE COVERING MATERIAL

An important ingredient of pipe covering material used on U. S. Navy vessels is amosite. This mineral is a magnesium iron silicate of variable composition. The name is the generic one for an asbestos type of fibrous mineral mined in South Africa.

The chief reasons for the wide use of amosite felt and pipe covering in naval work are its low thermal conductivity, light weight, strength, and refractoriness. When the felt and pipe covering were first developed, we were still building vessels under the Washington Treaty of Limitations in Tonnage, and every pound saved meant that much more armor, guns or ammunition for a given displacement, to say nothing of more economic operation for the weight involved in insulation.

Amosite pipe covering weighs about 14 pounds per cubic foot, with a temperature limit of 750°F. as compared to magnesia with a weight of 16 pounds per cubic foot, and a temperature limit of 500° F. High temperature amosite pipe covering weighs about 18 pounds per cubic foot as compared to 26 pounds per cubic foot for other high temperature insulations. Because of the lower conductivity and the higher temperature limit of the amosite type, less of it need be used in a combination covering than other types of insulations.

The development of amosite felt started in 1934 when a need existed to secure a thermal insulation lighter in weight and thermally more efficient than the materials (blocks and cement or asbestos blankets) which were then being used on destroyer turbines. The Navy approved the type developed by a manufacturer in September, 1934. Originally amosite was used only for turbine insulation, but it proved so satisfactory that its field of application enlarged to include insulation of valves, fittings, flanges, etc. From the initial destroyer, it has been used on almost all the destroyers built since that time and on all other combat vessels built since before the War.

Pipe covering was a later development in late 1935 and early 1936. Due to the manufacturing problems involved, it took a longer time to evolve into a satisfactory shape, and its first use on naval vessels was in 1937. Since that time its use has spread markedly and it was used on the great majority of naval combat vessels built during World War II.

Water-repellent amosite felt was developed during the early part of 1942, as a replacement for hair felt in the insulation of cold water lines to prevent sweating. Hair felt had the disad-

* Received for publication September 21, 1945. Published by permission of the U. S. Navy. The opinions and assertions contained herein are the private ones of the writers, and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

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[2] Lieut. H(S) USNR, Health Consultant.
[3] Lieut. H(S) USNR, Health Consultant.
[4] Chief Health Consultant, U. S. Maritime Commission.

vantage of being combustible and as it was organic, when it became wet it moulded or rotted and could harbor vermin. At this time fires on board certain naval vessels convinced the Navy of the desirability of eliminating any combustible material from on board ship. Eventually water-repellent amosite was made in strips of 50 foot lengths and of suitable width to enclose the circumference of the pipe and enclosed in an extremely light-weight muslin to facilitate handling and reduce the dust, which the water-repellent agent accentuated.

I. Description of Operations and Working Environment

Asbestosis results from breathing asbestos fibers of relatively long length, such as 15 to 75 microns. It is not caused by breathing chopped up asbestos fibers of one or two microns (1). Therefore we are concerned with the presence in air of asbestos fibers which can be seen as such under low power of the ordinary microscope.

The clinical picture of asbestosis can easily be complicated by the presence of diatomaceous earth, a form of amorphous silica, which can cause silicosis and is probably a more serious health risk than asbestosis.

Another dust which may be present is magnesia, MgO, which is in very common use as a heat insulator and is harmless.

Therefore our analyses were done to indicate how much fibrous type of asbestos dust was present in the air breathed, how much silica was present (especially as diatomaceous earth), and how much of the harmless ingredients like iron oxide and carbonates.

Pipe covering may be divided into seven different operations as follows:

1. *Laying out and cutting*
2. *Band saw cutting*
3. *Sewing and preparation of boots and jackets*
4. *Cement mixing*
5. *Molding*
6. *Grinding*
7. *Installation on board ship*

1. *Laying out and cutting*

Rolls of the insulating felt are unwrapped and unrolled on a large layout table or on the floor of the shop. This material, with the exception of the type known as water repellent amosite, is then well wetted with a fine water spray. It is marked into measured sections and cut with a rotary electric hand saw. The cut sections are rolled up and either used immediately or stacked in the storeroom.

Usually one to three workers are employed at this operation. During the handling, unwrapping and unrolling of the asbestos, considerable dust arises, but appears to settle readily. A very fine water spray should be used for wetting down the material as a high velocity spray stirs up dust. Once it is wetted the handling and cutting of the material causes little visible dust. All of the four yards surveyed wet down the insulating material described above.

One Navy Yard has an elaborate exhaust system for the layout table. The entire top of this table is covered with small perforations through which the air is exhausted. This table is sufficiently large that no more than two-thirds of the top is ever covered with material and room air is thereby exhausted through the other third. While no velocity or capacity measurements were made on this system, data presented later in the report indicate that this control measure had a marked effect in reducing the dust count.

2. *Band saw cutting*

A standard band saw such as is found in woodworking shops is used to cut insulation blocks and boards into desired shapes. This operation produces large amounts of air-borne dust, most of which settles slowly. Normally there is only one worker on this operation at any one time.

Inasmuch as this is a very dusty operation, the band saw should be enclosed in a room by itself and should be equipped with adequate local exhaust ventilation both above and below the saw table. Because of the mechanical difficulties in locating this exhaust properly, some of the dust will escape into the air and the operator should therefore wear an approved dust respirator.

3. *Sewing and preparation of boots and jackets*

In this operation jacket covers for valves and pipe joints are fabricated. The work consists of cutting asbestos cloth with shears, padding the jackets with insulating material, and sewing with wire or asbestos cord. These operations give rise to only slight amounts of visible dust, and exhaust ventilation and respiratory protection are neither required nor used. There is usually a large number of workers doing this operation in one large room.

4. *Cement mixing*

For protection and to give a neat appearance the insulation on board ship is usually covered with cement containing a high percentage of asbestos fibers. In mixing, the proper amount of water is added to the dry asbestos cement and thoroughly agitated with a hoe. Occasionally small amounts of asbestos cement are mixed in a pail with a trowel. Considerable dust is raised when the asbestos cement is dumped into the mixing trough and during the early stages of mixing. Ordinarily this process is done in a separate room and only one operator is exposed. The dustiness of this operation warrants the use of exhaust ventilation or respiratory protection or both, although neither is generally used.

Petrographic analyses of asbestos cement indicate that the amount of diatomaceous earth may be as high as 87 per cent by count.

5. *Molding*

Molding is the process of building up the insulation to fit odd shapes of boilerwork and piping. A form is made to the exact shape of the part to be insulated. Block insulation is laid on, adjoining sections glued together, exposed surfaces sealed with asbestos cement and the whole mold covered with asbestos cloth. When dry, the molded insulation can be lifted off the form and is ready to be installed on board ship. This operation is usually done in the shop next to the sewing operation. Very little dust is produced from this operation and no special ventilation or respiratory protection is required.

6. *Grinding*

Several shipyards reclaim their scrap pieces of prefabricated sections of insulation by grinding up this material and using it in the asbestos cement, all of which contributes considerable dustiness. Normally this job is done at infrequent intervals and only one or two men are exposed, but the operation should be isolated, general room exhaust supplied and an approved respirator worn by the operator.

7. *Installation of pipe covering on board ship*

There are a number of operations involved in pipe covering on board ship. Insulation felt is wrapped and pounded tightly around large pipes and joints and fastened firmly in place with wire or asbestos cord. Pipes and boilers are covered with prefabricated sections, which necessitates some hand sewing to fit the sections. Ready mixed cement is applied to fill in spaces and give a smoother finish. Some insulation is wrapped with glass cloth or asbestos cloth for greater strength. The only operations that produce much dust are the wrapping and pounding of amosite and the sewing of sections.

Nearly all of the compartments on board ship are involved in this work, although most of it is concentrated in the machinery spaces. Usually the greater number of pipe coverers work on board ship and relatively few men in the shop. The spacing of workers ranges from one or two men doing a small job in a living space to as many as twenty or thirty men working on ten or more jobs in the engine room. Temporary exhaust ventilation is seldom used on board ship for pipe covering and very few of the workers wear respirators.

Because of the varied nature of pipe covering operations in ship compartments, general exhaust ventilation is to be preferred. If the compartment is large, such as the main engine room, five air changes per hour are needed. In small compartments, such as living spaces, ten to fifteen air changes per hour are required.

II. Composition of Materials Used

According to Navy Specification the rovings of asbestos insulating felt (amosite) shall contain not less than 95 per cent asbestos fiber of the following composition:

Silica (SiO_2) per cent minimum	47.5
Iron oxide (Fe_2O_3) per cent maximum	45.0
Magnesium oxide (MgO) per cent minimum	6.0

Typical analysis of the two types of asbestos fibers in general use are tabulated below:

	Chrysotile	*Amosite*
Silica (SiO_2)	39.05%	50.24%
Magnesia (MgO)	40.07%	3.96%
Alumina (Al_2O_3)	3.07%	
Ferric oxide (Fe_2O_3)	2.41%	7.80%
Ferrous oxide (FeO)		32.00%
Sodium oxide (Na_2O)		2.12%
Combined water (H_2O)	14.48%	3.00%

Therefore amosite alone will not comply with Navy Specifications because of the low magnesia content and must be mixed with chrysotile asbestos to equal or exceed the 6.0 per cent minimum value for magnesia. On the other hand, chrysotile cannot be used alone because of its silica content which is below the minimum 47.5 per cent specified by the Navy. The two types

of asbestos fibers must be mixed together in the proper proportions to satisfy the values set for magnesia and silica. The amounts of these materials used to form this mixture therefore would be 6–43 per cent chrysotile asbestos and 94–57 per cent amosite asbestos.

These two fibers differ mainly in their physical characteristics. Chrysotile is capable of being readily separated into very fine fibers with a soft silky feel, whereas amosite is harsher and requires more manipulation to fiberize it. One authority has stated that the chrysotile has the finest individual fibers, and amosite the coarsest. Because of this difference we may suspect a decided decrease in the number of respirable fibers (below 200 microns in length and 5 microns in diameter) whenever amosite is used in preference to chrysotile asbestos.

TABLE 1

SUMMARY OF MATERIALS USED AT EACH YARD PER MONTH

	NAVY YARD A	NAVY YARD B	CONTRACT YARD C	CONTRACT YARD D
Amosite	58,200 sq. ft.	50,000 sq. ft.	40,000 sq. ft.	6,325 sq. ft.
Amosite (water-repellent)	—	15,000 sq. ft.	—	3,300 sq. ft.
Prefabricated sections (molded and block)	600 sq. ft. 39,900 linear ft.	1,200 sq. ft. 115,000 linear ft.	1,750 sq. ft. 18,800 linear ft.	15,700 linear ft.
Asbestos cloth	76,500 sq. ft.	106,600 sq. ft.	34,700 sq. ft.	40,050 sq. ft.
Metallic twine Asbestos yarn	—	150 lb.	—	—
Asbestos paper	—	5,500 sq. ft.	4,000 sq. ft.	5,500 sq. ft.
Asbestos board	2,700 linear ft.	6,000 sq. ft.	150 sq. ft.	—
Asbestos cement	34,400 lb.	15,000 lb.	57,500 lb.	38,500 lb.

III. Pipe Covering Facilities at Individual Shipyards

U. S. Navy Yard A.

There were 84 men working in the shop and 467 men on board ship. The shop was divided into two rooms, one of which was primarily for storage and occasional grinding and band saw cutting operations. The only mechanical exhaust ventilation in the shop was provided for the grinding, mixing and band saw cutting operations and was inadequate. In the other room layout, cutting and sewing were done with a small amount of space for storage. Cross draft ventilation was provided by open windows on both sides of the room.

Work on board ship was not supplied with exhaust ventilation.

No asbestos workers were found wearing respirators.

U. S. Navy Yard B.

There were 50 men working in the shop and 700 men on board ship. The shop was divided into four main rooms: Layout, Sewing, Cement, and Storage and Band saw combined. With the exception of the Cement Room, the doors between these were normally left open.

The work in the Sewing Room consisted mostly of fabricating and sewing valve boots and jackets. All the cement used on board ship was mixed in the Cement Room. There was no exhaust ventilation for either the Sewing or Cement Room. The band saw was equipped with a flexible exhaust tube above the table and an exhaust around the blade below the saw table. The layout table was equipped with exhaust ventilation as described above. There was no exhaust ventilation supplied on board ship for pipe covering and no workers were found wearing respirators.

Contract Yard C.

There were 51 men working in the shop and 123 on board ship. Layout, cutting and cement

mixing were done at one end of the shop. Dust respirators were occasionally worn during these procedures. At the other end of the shop the fabrication of boots, jackets and molds were carried out. A small amount of such fabrication was done on board ship.

Material was cut with a band saw in a separate room and the operator wore an approved dust respirator. The dust from this saw was exhausted through a slot under the table which caught only a part of the dust given off above the table.

There was no exhaust ventilation in the shop, other than for the band saw, and none for the pipe covering operations on board ship. All floors, walls and rafters of the shop were cleaned at frequent intervals with an industrial vacuum cleaner. Most pipe covering on board ship was applied in the evening during the second shift.

Contract Yard D.

There were 8 men in the shop and 160 men working on board ship. Pipe covering operations were done in two shops. In the main one, boots and jackets for pipe valves and connections were fabricated and surplus material stored. In the smaller shop the operations consisted of layout and cutting of amosite, water repellent amosite and fire felt. There was no exhaust ventilation in either shop nor for the pipe covering operation on board ship. All the asbestos cement was mixed in a compartment on board ship. The only worker who wore an approved dust respirator was the man who cut the two types of amosite. There was no band saw cutting of asbestos in this yard.

IV. Analyses of Settled Dust and Dust Counts

There are no established figures for permissible or safe dustiness in pipe covering operations. Dreessen et al. (2) in their study of asbestosis in the asbestos textile industry suggested 5 million particles of total dust by impinger as a threshold for that industry. We should like to point out that the asbestos textile and asbestos pipe covering industries differ widely in their dust exposures. In textile plants workers usually continue at specific jobs with fairly constant dust exposures for some years, whereas the pipe coverer may rotate between shop and ship and from small to large ship compartments with a wide variation in dust exposure.

In contrast to the textile worker, the pipe coverer's materials differ markedly in their asbestos content, ranging from 85 per cent magnesia (10–15% asbestos) to amosite (95% asbestos). When asbestos cements contain large amounts of diatomaceous earth there is a resultant silicosis hazard as indicated above.

In general we feel that dust counts below 5 million particles per cubic foot by Konimeter indicate good dust control.

Our figures in Table 2 were determined by the Konimeter and not with the impinger instrument. We used the Konimeter because it is light, easily portable and takes records which can be kept indefinitely. As is indicated in Table 3, the dustiest operations are band saw cutting, cement mixing, and installation on board ship.

V. Medical Findings

The incidence of asbestosis among pipe coverers as determined by chest X-ray is given in Table 4. The relation between years of exposure and per cent asbestosis is included in Table 5.

Due to frequent turnover of shipyard workers and the length of time required to X-ray a large number of workers, the number X-rayed may not equal the number of pipe coverers. At Contract Yard C X-rays were examined of men who had left the yard while at Navy Yard B a few pipe coverers were not X-rayed. At Navy Yard A the 48 X-rayed out of 551 were all older men working in the shop.

Some of these pipe coverers had had pre-shipyard experience in the asbestos industry, but the tables are based solely on shipyard exposure. At Contract Yard C, for example, the Asbestos Shop estimated that about one-third of their pipe coverers had worked with asbestos before coming to the yard.

The one case of advanced asbestosis at Contract Yard C had worked in the asbestos industry for 23 years before coming to work in the yard. At Contract Yard D the two cases of moderate asbestosis had worked 22 years and 30 years at pipe covering in their yard.

All of the X-ray films used in the above data were first read by roentgenologists of the Medical Department of the yard and then by one of the authors (W. E. F.). Dr. W. C. Dreessen, U. S. P. H. S., was kind enough to examine the three positive plates and he agreed on the diagnosis.

Since only three workers out of the 1074 X-rayed had asbestosis, and each of the three had been a pipe coverer for more than 20 years, it would

TABLE 2

ANALYSES OF SETTLED DUST AND AIR SAMPLES

OPERATION	PER CENT LESS THAN 10 MICRONS BY COUNT	ASBESTOS (UNDER 200 MICRONS)	PER CENT LESS THAN 10 MICRONS BY COUNT						DUST COUNTS (MPPCF)*					
			Halloysite & earth	Serpentine	Other fibers (organic & glass)	Iron oxide (rouge)	Carbonates and oxides	Others	Number of samples	Total dust		ASBESTOS DUST		PER CENT ASBESTOS (LENGTH)
										Range of counts	Average	Range of counts	Average	
Layout and cutting														
Navy Yard A	95	16	6	12	6	24	26	10	2	3.5– 8.7	6.1	0.21–0.50	0.35	3.7– 6.0
Navy Yard B	98	10	8	12	tr	40	18	12	7	1.6– 6.5	4.2	0.01–0.54	0.23	0.6– 7.9
Contract Yard C	95	30	5	10	tr	26	14	15	4	17.1– 25.2	20.5	1.13–4.30	2.18	6.6–19
Contract Yard D	95	26	6	8	tr	29	21	10	5	6.5– 16.5	10.9	0.09–1.16	0.63	1.4– 8.7
Cutting with band saw														
Navy Yard A									2	11.0– 19.2	15.1	0.10–0.14	0.12	0.7– 0.9
Navy Yard B	98	9	7	8	tr	48	16	12	2	32.4– 46.6	39.5	2.8– 3.2	3.0	6.5– 8.7
Contract Yard C	98	9	63	2	tr	10	4	12	3	18.2–100+	73+	.9–12.8	6.19	4.3–12.8
Molding operations														
Contract Yard C	98	8	66	3	tr	7	6	10						
Contract Yard D	95	4	9	7	tr	38	10	12						
Sewing & prep. of boots & jackets														
Navy Yard A									2	3.5– 6.1	4.6	.01– .06	0.03	0.3 –1.0
Navy Yard B (Sewing asbestos cloth)	98	12	tr	9	tr	42	21	16	3	3.3– 6.0	6.5	0.0– 9.4	0.1	0. –6.4
(Stuffing with amosite)	98	8	8	11	tr	38	20	15	1	2.1–	2.1	0.	0.3	0.
Contract Yard C	95	26	6	11	3	28	12	14	2	10.6– 12.3	11.4	.45– .79	.62	3.7 –7.4
Contract Yard D	98	6	6	8	tr	38	28	14	5	3.9– 10.9	6.0	0. – .05	.03	0. –0.5
Storeroom														
Contract Yard D	95	15	8	7	tr	26	32	12						
Cement mixing														
Navy Yard A									16	5.4– 30+	31+	0. –0.52	0.2	0. – 0.7
Navy Yard B									2	67. –100+	84+	1.6 –1.7	1.7	1.4– 2.5
Contract Yard C									2	33.8– 48.7	41.3	1.6 –4.7	3.1	4.7–10.0
Contract Yard D (on board ship)									5	19.6– 40.0	32	0. – .02	.01	0. – .001
Grinding scrap materials														
Navy Yard A	88	8	20	16	1	10	33	12	15	9.4–100+	50+	0. –1.6	.47	0. –2.6
General room														
Navy Yard A									49	0.2– 24.6	10.0	0. –1.4	0.08	.02–0.3
Navy Yard B									2	1.6– 3.3	2.4	0. – .01	.01	0. –0.6
Contract Yard C									4	0.0– 21.6	14.2	0.34–1.7	.8	3.8 –7.9
Contract Yard D									5	3.9– 10.9	6.0	0. – .03	.02	0. –0.5
Aboard ship														
Navy Yard A									30	65. –250.	142	0. –0.17	0.02	0. –0.05
Navy Yard B									15	84.4–192.0	128	1.56–5.21	2.8	1.1 –3.7
Contract Yard C									15	25.3– 89.0	49.2	0.23–2.35	1.10	0.5 –6.3
Contract Yard D									15	8.0– 22.1	11.0	0. –0.21	0.03	0. –1.0

* *Note:* MPPCF = Million particles of dust per cubic foot of air.

TABLE 3

COMPARISON OF DUSTINESS OF VARIOUS OPERATIONS IN EACH SHIPYARD

OPERATION	NAVY YARD A		NAVY YARD B		CONTRACT YARD C		CONTRACT YARD D	
	Total dust	Asbestos dust	Total dust	Asbestos dust	Total dust	Asbestos dust	Total dust	Asbestos dust
	MPPCF*		MPPCF		MPPCF		MPPCF	
Layout and cutting	6.1	0.35	4.2	0.23	20.5	2.18	10.9	0.63
Band saw cutting	15.1	0.12	39.5	3.0	73.0	6.19		
Sewing and fabrication	4.8	0.03	44.8	0.1	11.4	0.62	6.0	0.03
Cement mixing	31.0	0.2	84.0	1.7	41.5	3.1	32.0	0.01
Grinding	50.0	0.47						
General room	10.0	0.08	2.4	0.01	14.2	0.8	6.0	0.02
Shop average	30.0	0.25	26.9	1.0	32.0	2.6	7.6	0.23
Ship average	142.0	0.02	128.0	2.8	49.2	1.1	11.0	0.03

* *Note:* MPPCF = Million particles of dust per cubic foot of air.

TABLE 4

INCIDENCE OF ASBESTOSIS AMONG PIPE COVERERS

SHIPYARD	NUMBER OF PIPE COVERERS	NUMBER X-RAYED	NUMBER OF CASES OF ASBESTOSIS		
			Minimal	Moderate	Advanced
Navy Yard A	551	48	0	0	0
Navy Yard B	750	662	0	0	0
Contract Yard C	174	196	0	0	1
Contract Yard D	168	168	0	2	0
Totals	1683	1074	0	2	1

TABLE 5

RELATIONSHIP BETWEEN LENGTH OF EXPOSURE AND INCIDENCE OF ASBESTOSIS

SHIPYARD		YEARS IN PIPE COVERING INDUSTRY			
		0-2	2-5	5-10	10 plus
Navy Yard A	Exposed	26	13	8	3
	Affected	0	0	0	0
	Percentage	0%	0%	0%	0%
Navy Yard B	Exposed	225	433	67	22
	Affected	0	0	0	0
	Percentage	0%	0%	0%	0%
Contract Yard C	Exposed	0	105	45	17
	Affected	0	0	0	1
	Percentage	0%	0%	0%	6%
Contract Yard D	Exposed	26	118	8	9
	Affected	0	0	0	2
	Percentage	0%	0%	0%	22%

appear that asbestos pipe covering of naval vessels is a relatively safe occupation. However, it must be remembered that these men rotated among the various operations of pipe covering and were not continually exposed to high concentrations of asbestos dust as found in band saw cutting and cement mixing. The suggestions made relative to exhaust ventilation and respiratory protection are therefore of value in maintaining this low incidence of asbestosis.

DISCUSSION

The extremely low incidence of asbestosis found, 0.29 per cent, or 3 cases out of 1074 pipe coverers, stands in marked contrast to the high dust concentration found in several of the pipe covering operations. As shown in Table 3, the total dust concentration for band saw cutting ranged from 13.1 to 73.0 million particles per cubic feet, for cement mixing from 31.0 to 84.0, and for installation on board ship, from 11.0 to 142.0. The solution of this apparent discrepancy lies in a characteristic peculiar to the pipe covering trade, that is lack of a necessity for specialization. In general, pipe coverers are capable of doing all of the operations described above, and the worker may be changed from one operation to another or to different jobs in the same type of operation without loss of efficiency and according to the demands of ship construction. It is therefore apparent that a pipe coverer's environment may change every few days or few weeks at the most with a constant fluctuation in the dust concentration which he breathes. Therefore, the figures given in Table 3 for shop average and ship average cannot give a composite picture of the asbestos

dust that a worker may breathe over a period of years. It is further apparent that to obtain such a picture, daily dust counts at each specific job in each ship compartment and in the shop together with the time spent on each job would have to be compiled separately for each worker. In this respect, asbestos pipe covering differs markedly from the asbestos textile industry where dust concentrations for an operation do not fluctuate widely and where a worker will usually remain at a specific job for some years.

A further factor in maintaining a low incidence of asbestosis is that in band saw cutting, grinding, and cement mixing only one or two men are involved and the work is usually done at infrequent intervals such as several times a week.

Finally, pipe coverers also apply glass wool, rock wool, magnesia, and other types of non-asbestos insulation, all of which decreases the amount of exposure to asbestos dust. It seems likely to us that if the pipe coverers studied had worked steadily at any of the above operations where the amount of asbestos dust in the air was consistently high, the incidence of asbestosis among these workers would have been considerably greater. In view of the varied character of the environmental dust exposure in the pipe covering industry on naval vessels, it is manifestly impossible to set a threshold.

VI. Conclusions

1. The character of asbestos pipe covering industry on board naval vessels is such that conclusions drawn from other asbestos industries such as textiles, cannot be applied.

2. The operations of band saw cutting, grinding, cement mixing, and installation on board ship should be equipped with exhaust ventilation to keep the total dust concentration low.

3. The incidence of asbestosis among pipe coverers in the shipyards studied was low, 0.29 per cent or 3 cases out of 1074. In view of the nature of shipyard pipe covering work, this low incidence is not surprising.

4. Since each of the 3 cases of asbestosis had worked at asbestos pipe covering in shipyards for more than 20 years, it may be concluded that such pipe covering is not a dangerous occupation.

References

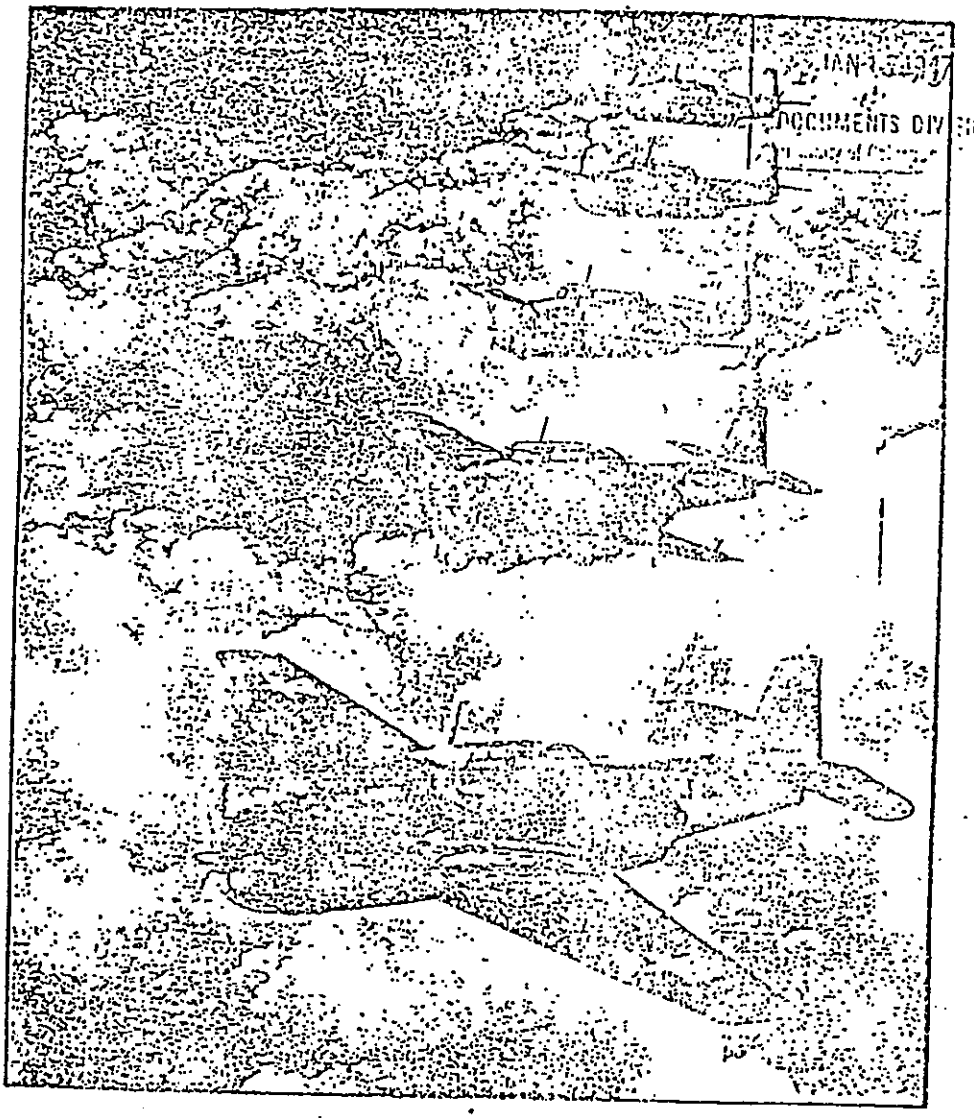
(1) Lanza, A. J.: Silicosis and asbestosis. Oxford University Press, New York, New York, 1938.

(2) Dreessen, W. C. et al.: A study of asbestosis in the asbestos textile industry. Bull. No. 241, Public Health Service, U. S. Treasury Department, 1938.

(3) Fahey, J. C.: Ships and aircraft of the United States Fleet. 2nd War Edition, 1944. Published by Ships and Aircraft, 1265 Broadway, New York, New York.

Exhibit 13

SAFETY REVIEW



NAVEXOS P-52

Vol. 4, No. 1
Jan. 1947

FOUNDRY DUST

ONE of the elements in effective control of silicosis in foundry operations is the maintenance of the highest standards of housekeeping. One phase of the housekeeping program should include periodic removal, on a scheduled basis, of the dust which has settled on overhead obstructions, girders, conduits, catwalks, and other fixed objects where dust in the general atmosphere may settle and come to rest. Several of the shore establishments, realizing the importance of good housekeeping conditions in keeping down concentrations of dust in the general foundry atmosphere, make use of industrial vacuum-cleaning systems for the periodic removal of dust which has settled on overhead structural members and equipment.

The importance of developing and maintaining such a housekeeping program is emphasized in the following report submitted recently by the Boston Naval Shipyard:

"Personnel working in the foundry have complained of the material which is deposited overhead and elsewhere in the foundry and drops down when the building vibrates; a laboratory analysis of a sample of this deposit follows:

Tin	(as SnO_2)	9.64
Lead	(as Pb)	2.09
Copper	(as Cu)	2.06
Silica	(as SiO_2)	2.64
Sulphur	(as S)	4.50

Zinc Oxide .....The remainder, with the lead, copper and part of the zinc present as sulfides in the sample.

"In that the inhalation of heavy metal dusts is considered a contributing factor to metal-fume fever, the need for protective measures is obvious and again urged."

ASBESTOS DUST

EXPOSURE to asbestos dust is a health hazard which cannot be overlooked in maintaining an effective occupational-hygiene program. Adequate localized ventilation to maintain dust concentrations below the safe threshold limits must be utilized wherever possible, and, if circumstances warrant these should be supplemented by general-room ventilation. Activities engaged in the handling of asbestos installation and pipe covering should thoroughly investigate the environmental conditions under which these operations are performed, taking the necessary dust counts and checking existing ventilating facilities to insure that the hazard is being effectively and continuously controlled. In those instances where mechanical exhaust ventilation must be supplemented by the wearing of personal protective equipment, personnel exposed to such hazards should be furnished the Navy half mask, conforming to BuShips Ad Int. Specification, Masks (for Protection of Respiratory Organs from Toxic Fumes and Dust), dated 16 September 1946, 3743, Type C, Class 1, Filter-Pad Masks.

The following report from the Naval Shipyard, Portsmouth, New Hampshire, records the results of an investigation conducted at that activity:

"There were two investigations of occupational-health exposures during the month of October.

I (a) Conditions in the Asbestos Insulation and Pipe-Cover Section of Bldg. 174 were investigated and it was found that the dust count in this section was upward of 5 m./cu.ft.

(b) Recommendations were made as follows:

1. That the asbestos covering process be confined to as small a section of the shop as possible.
2. That proper ventilation be secured.
3. That appropriate respirators be worn by the workers.
4. That instruction be given workers in the use of respirators."

FLAMEPROOFING OF TEXTILES

THE National Bureau of Standards recently announced "Circular C 455, Flameproofing of Textiles," which sets forth most recent results of research to develop treatments which reduce the flammability of textiles and make them reasonably resistant to effects of water. It also gives a new method for determining the relative flammability of untreated textiles. Requests for this publication should be sent to the Safety Branch, Office of Industrial Relations, Building K-1006, Navy Department, Washington 25, D. C.

Exhibit 14

DEPARTMENT OF THE NAVY
Bureau of Medicine and Surgery
Washington 25, D. C.

BUMED 6260-5
BUMED-7231-JS-cac
7 November 1955

BUMED INSTRUCTION 6260.5

From: Chief, Bureau of Medicine and Surgery
To: All Ships and Stations

Subj: Threshold limit values for toxic materials

Encl: (1) Table of Threshold Limit Values

1. Purpose. To establish as a basic reference the threshold limit values of toxic materials, adopted by the American Conference of Governmental Industrial Hygienists, and to provide guidance toward the reduction of potential health hazards encountered in the industrial environment for both military and naval civilian personnel.

2. General

a. Definition. The term "threshold limit values" as used herein is intended to indicate the maximum average atmospheric concentrations of contaminants to which personnel may be exposed during an 8-hour workday, over a prolonged period of time, without adversely affecting their health. The threshold limit values should be used as a guide in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentrations. The most desirable levels in all cases are those approaching zero, but practical considerations frequently require the acceptance of higher levels which are safe but not ideal.

(1) The term "maximum allowable concentrations" is to be considered synonymous with the term "threshold limit values" defined above.

b. Threshold Limits. The threshold limit values contained in enclosure (1) are based on the best available toxicological information, long-term industrial experience, and experimental studies. Inasmuch as these values are constantly being reevaluated, revisions or additions will be made as further information becomes available.

c. Exposure to Ionizing Radiation. Threshold limits for exposure to ionizing radiation have been omitted from this Instruction. These exposures are adequately covered in NavMed P-1325, Radiological Safety Regulations.

ENCLOSURE (1)

DEFENDENT'S EXHIBIT
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d. Limitations. The enclosed listing of threshold limit values for various chemicals does not constitute authority for the procurement or use of these items.

3. Action. The medical officer or medical department representative of each ship and station concerned shall take the following action:

a. Survey industrial operations utilizing the information contained in enclosure (1) to assist in the identification and control of potential industrial health hazards.

b. Make recommendations to the commanding officer for specific corrective actions, when required.

c. When specialist assistance for adequate survey of a ship or shore station is desired, requests should be initiated through the proper channels for the services of an industrial hygienist. This may be done in accordance with procedures outlined in NCPI 88, or by request direct to the Bureau of Medicine and Surgery.

B. W. HOGAN

THRESHOLD LIMIT VALUES

Abbreviations Used. The following abbreviations are used:

PPM	Parts per million
Mg. per cu. m. (mg/M³)	Milligrams per cubic meter
MPPCF	Million particles per cubic foot

Established Values

Adopted at the 17th annual meeting of the American Conference of Governmental Industrial Hygienists, Buffalo, 24-28 April 1955.

Gases and Vapors

Substance	PPM
Acetaldehyde	200
Acetic acid	10
Acetic anhydride	5
Acetone	1000
Acrolein	0.5
Acrylonitrile	20
Ammonia	100
Amyl acetate	200
Amyl alcohol (isoamyl alcohol)	100
Aniline	5
Arsine	0.05
Benzene (benzol)	35
Bromine	1
Butadiene (1,3-butadiene)	1000
Butanone (methyl ethyl ketone)	250
Butyl acetate (n-butyl acetate)	200
Butyl alcohol (n-butanol)	100
Butyl cellosolve (2-butoxyethanol)	200
Carbon dioxide	5000
Carbon disulfide	20
Carbon monoxide	100
Carbon tetrachloride	25
Cellosolve (2-ethoxyethanol)	200
Cellosolve acetate (hydroxyethyl acetate)	100
Chlorine	1
Chlorobenzene (monochlorobenzene)	75
Chloroform (trichloromethane)	10*
1-Chloro-1-nitropropane	20
Chloroprene (2-chlorobutadiene)	25
Cresol (all isomers)	5
Cyclohexane	400
Cyclohexanol	200
Cyclohexanone	100
Cyclohexene	400
Cyclopropane	400

BUMEDINST 6260.5
7 November 1955

Gases and Vapors (Continued)

Substance	PPM
o-Dichlorobenzene	50
Dichlorodifluoromethane	1000
1,1-Dichloroethane	100
1,2-Dichloroethylene	200
Dichloroethyl ether	15
Dichloromonofluoromethane	1000
1,1-Dichloro-1-nitroethane	10
Dichlorotetrafluoroethane	1000
Diethylamine	25
Dimethylaniline (N-dimethylaniline)	5
Dimethylsulfate	1
Dioxane (diethylene dioxide)	100
Ethyl acetate	400
Ethyl alcohol (ethanol)	1000
Ethylamine	25
Ethyl benzene	200
Ethyl bromide	200
Ethyl chloride	1000
Ethyl ether	400
Ethyl formate	100
Ethyl silicate	100
Ethylene chlorohydrin	5
Ethylene dibromide (1,2-dibromoethane)	25
Ethylene dichloride (1,2-dichloroethane)	100
Ethylene oxide	100
Fluorine	0.1
Fluorotrichloromethane	1000
Formaldehyde	5
Gasoline	500
Heptane (n-heptane)	500
Hexane (n-hexane)	500
Hexanone (methyl butyl ketone)	100
Hexone (methyl isobutyl ketone)	100
Hydrogen chloride	5
Hydrogen cyanide	10
Hydrogen fluoride	3
Hydrogen selenide	0.05
Hydrogen sulfide	20
Iodine	1
Isophorone	25
Mesityl oxide	50
Methyl acetate	200
Methyl alcohol (methanol)	200
Methyl bromide	20
Methyl cellosolve (methoxyethanol)	25
Methyl cellosolve acetate (ethylene glycol monomethyl ether acetate)	25
Methyl chloride	100
Methylal (dimethoxymethane)	1000
Methyl chloroform (1,1,1-trichloroethane)	500
Methylcyclohexane	500

Enclosure (1)

Gases and Vapors (Continued)

Substance	PPM
Methylcyclohexanol	100
Methylcyclohexanone	100
Methyl formate	100
Methylene chloride (dichloromethane)	500
Naphtha (coal tar)	200
Naphtha (petroleum)	500
Nickel carbonyl	0.001
Nitrobenzene	1
Nitroethane	100
Nitrogen dioxide	5
Nitroglycerin	0.5
Nitromethane	100
2-Nitropropane	50
Nitrotoluene	5
Octane	500
Ozone	0.1
Pentane	1000
Pentanone (methyl propyl ketone)	200
Perchlorethylene (tetrachloroethylene)	200
Phenol	5
Phosgene (carbonyl chloride)	1
Phosphine	0.05
Phosphorus trichloride	0.5
Propyl acetate	200
Propyl alcohol (isopropyl alcohol)	400
Propyl ether (isopropyl ether)	500
Propylene dichloride (1,2-dichloropropane)	75
Stibine	0.1
Stoddard solvent	500
Styrene monomer (phenyl ethylene)	200
Sulfur monochloride	1
Sulfur dioxide	10
1,1,2,2-Tetrachloroethane	5
Toluene	200
o-Toluidine	5
Trichloroethylene	200
Turpentine	100
Vinyl chloride (chloroethene)	500
Xylene	200

Toxic Dusts, Fumes, and Mists

Substance	Mg. per cu. m.
Antimony	0.5
Arsenic	0.5
Barium (soluble compounds)	0.5
Cadmium	0.1
Chlorodiphenyl	1.

Toxic Dusts, Fumes, and Mists (Continued)

Substance	Mg. per cu. m.
Chromic acid and Chromates as CrO_3	0.1
Cyanide as CN	5
Dinitrotoluene	1.5
Dinitro-o-cresol	0.2
Fluoride	2.5
Iron oxide fume	15
Lead	0.15
Magnesium oxide fume	15
Manganese	0.1
Mercury	0.1
Parathion (O,O-Diethyl-O-p-nitrophenyl thiophosphate)	0.5
Pentachloronaphthalene	0.5
Pentachlorophenol	0.1
Phosphorus (yellow)	1
Phosphorus pentachloride	1
Phosphorus pentasulfide	0.1
Selenium compounds (as Se)	1
Sulfuric acid	1
Tellurium	0.1
Tetryl (2,4,6-trinitrophenylmethylnitramine)	1.5
Trichloronaphthalene	5
Trinitrotoluene	1.5
Uranium (soluble compounds)	0.05
Uranium (insoluble compounds)	0.25
Zinc oxide fumes	15

Mineral Dusts

Substance	MPPCF
Alundum (aluminum oxide)	50
Asbestos	5
Carborundum (silicon carbide)	50
Dust (nuisance, no free silica)	50
Mica (below 5% free Silica)	20
Portland cement	50
Talc	20
Silica	
high (above 50% free SiO_2)	5
medium (5 to 50% free SiO_2)	20
low (below 5% free SiO_2)	50
Slate (below 5% free SiO_2)	50
Soapstone (below 5% free SiO_2)	20
Total dust (below 5% free SiO_2)	50

Tentative Threshold Limit Values

The following tentative values have been suggested for further consideration and it is proposed that the entire list will be presented for adoption at the meeting of the American Conference of Governmental Industrial Hygienists in 1956, if no reason to the contrary is forthcoming.

Enclosure (1)

Tentative Threshold Limit Values (Continued)

Aldrin (1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a,-hexahydro-1,4,5,8-dimethanonaphthalene)	0.25	mg/M³
Allyl alcohol	5	ppm
Allyl propyl disulfide	2	ppm
Ammate (ammonium amidosulfate)	15	mg/M³
Benzyl chloride	1	ppm
Butyl amine	5	ppm
Butyl mercaptan	10	ppm
Calcium arsenate	0.3	mg/M³
Chlordane (1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane)	2.0	mg/M³
Chlorine trifluoride	0.1	ppm
Chlorinated diphenyl oxide	0.5	mg/M³
Crag Herbicide (sodium-2,4, dichlorophenoxy ethyl sulfate)	15	mg/M³
2,4-D (2,4-dichlorophenoxyacetic acid)	10	mg/M³
D.D.T. (2,2-bis-(p-chlorophenyl)-1,1,1- trichlorethane)	2.0	mg/M³
Diacetone alcohol (4-hydroxy-4-methyl pentanone-2)	50	ppm
Diborane	0.1	ppm
Dieldrin (1,2,3,4,10,10-hexachloro-6,7, epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-dimethanonaphthalene)	0.25	mg/M³
Difluorodibromomethane	100	ppm
Diisobutyl ketone	50	ppm
EPN (ethyl-p-nitrophenyl thiono benzene phosphonate)	0.5	mg/M³
Ethyl mercaptan	250	ppm
Ethylene diamine	10	ppm
Ethylene imine	5	ppm
Ferro vanadium dust	1	mg/M³
Furfural	5	ppm
Furfuryl alcohol	200	ppm
Hydrazine	1	ppm
Hydrogen bromide	5	ppm
Hydrogen peroxide, 90%	1	ppm
Hydroquinone	2	mg/M³
Isopropylamine	5	ppm
Lead arsenate	0.2	mg/M³
Lindane (hexachlorocyclohexane, gamma isomer)	0.5	mg/M³
Malathon (O,O-dimethyl dithio phosphate of diethyl mercaptosuccinate)	15	mg/M³
Methoxychlor (2,2,diparamethoxyphenyl-1,1,1, trichloroethane)	15	mg/M³
Methyl acetylene	1000	ppm
Methyl isobutyl carbinol (methyl amyl alcohol)	25	ppm
Methyl mercaptan	50	ppm
Molybdenum		
(soluble compounds)	5	mg/M³
(insoluble compounds)	15	mg/M³
p-Nitroaniline	1	ppm
Organo mercurials (as mercury)	0.01	mg/M³
Perchloromethyl mercaptan	0.1	ppm
Phenylhydrazine	5	ppm
Picric acid	0.1	mg/M³
Propylene imine	25	ppm
Pyridine	10	ppm
Quinone	0.1	ppm

BUMEDINST 6260.5
November 1955

Tentative Threshold Limit Values (Continued)

...ium hydroxide	2	mg/M³
...ur hexafluoride	1000	ppm
Sulfur pentafluoride	0.025	ppm
TEDP (tetraethyl dithiono pyrophosphate)	0.2	mg/M³
TEPP (tetraethyl pyrophosphate)	0.05	mg/M³
p-Tertiary butyl toluene	10	ppm
Tetrahydrofuran	75	ppm
Tetranitromethane	1	ppm
Titanium dioxide	15	mg/M³
Trifluoromonobromomethane	1000	ppm
Vanadium		
(V_2O_5 dust)	0.5	mg/M³
(V_2O_5 fume)	0.1	mg/M³
Zirconium	5	mg/M³

...closure (1)

Exhibit 15

GENERAL SAFETY RULES

MANUAL

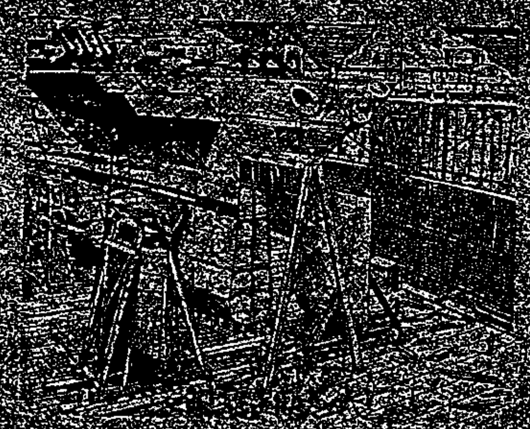
P ★ S ★ N ★ S

GREEN CROSS FOR SAFETY

13ND—PSS
1950

PUGET SOUND NAVAL SHIPYARD

BREMERTON, WASHINGTON



GENERAL SAFETY RULES MANUAL

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13ND-P35

PUGET SOUND NAVAL SHIPYARD
BREMERTON, WASHINGTON
1950

I

Shipyard GENERAL SAFETY RULES

A. General:

A1. All supervisors shall be responsible for enforcement of safety rules and thorough safety instruction of employees under their charge.

A2. Keep your mind on your work, always. Practical joking and horseplay are prohibited.

A3. Report promptly any unsafe conditions noted. Persons accepting such reports are responsible for following the matter through to a logical conclusion.

A4. Watch out for your fellow workers. Warn them of any dangerous situations.

A5. Watch your step! Avoid short cuts through dangerous areas.

A6. Running in the Shipyard is not allowed, except in cases of real emergency, or where approved by the supervisor as necessary for the efficient conduct of the job at hand.

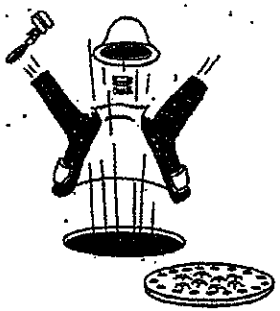
A7. Do not jump from heights.

A8. Never throw tools or materials to another worker.

A9. Don't lean against or sit on any railing or life-line.

A10. Barriers are placed around the job for your protection. Never go through or under a barrier without specific orders.

A11. Keep off of all equipment such as cranes, shovels, trucks, caterpillars, pile drivers, etc., unless an authorized requirement of your work.



A12. All open man-holes, hatches and deck openings must be guarded with safety line or hand rails.

A13. All flush deck openings must be provided with toe boards to prevent materials, tools, etc., from falling below.

A14. No unauthorized person shall remove, displace, damage, or destroy any safety device, safeguard, notice or warning furnished for use in any place of employment.

A15. Wearing of finger rings, wrist watches and watch chains is prohibited when handling materials, tools or working around moving machinery.

A16. Do not enter closed compartments or voids until they have been ventilated, tested, and authorized for entrance.

A17. All cans, drums or bottles containing chemicals shall be clearly labeled to show name of chemical and its flammability or toxicity.

A18. When mixing acid and water, always pour the acid into the water slowly. NEVER pour water into acid. Approved goggles and rubber gloves shall be worn.

A19. In case you get acid or caustic into your eyes or on your skin, bathe immediately with large quantities of clean water and report to the Dispensary without delay. Before starting such work, note location of emergency showers, drinking fountain or other source of water.

A20. Safety valves, governors, over-speed trips, automatic cutouts, limit switches, fuses and similar safety devices are installed to prevent failure of equipment with resultant serious injury or

damage. Such devices must not be altered or tampered with in any way and shall be repaired or adjusted only by authorized persons. Report any difficulties with safety devices to your supervisor at once.

A21. Switches, valves or other equipment controls, movement of which may endanger personnel working on lines or machinery shall be locked or tagged out by the man in charge of the work before permitting work thereon. Where more than one man is working independently on the equipment, each shall place his own tag on the control.

A22. Safety locks or tags shall be removed, when no longer needed, only by the person who put them in place. Emergency removal, in the unavoidable absence of such a person may be accomplished under the direction of the employee's senior civilian supervisor.

B. Personal Clothing:

B1. Always wear proper clothing. Ragged sleeves, cuffed trousers, gloves, loose ties or jumpers, will not be permitted around moving machinery. Rolled up sleeves are dangerous. If you like your sleeves short, cut and hem them above the elbow.

B2. Keep work clothing clean. Dirty clothes are a menace to health as well as a fire hazard if oily.

B3. Never put oil-soiled clothing or rags in lockers. They can ignite spontaneously.

B4. Celluloid visors on caps and shields are highly inflammable and shall not be used in the shipyard.

B5. Workers exposed to hot sparks or molten metals should wear hard cloth or wool clothing. Congress type safety shoes are recommended.

B6. All employees shall wear shoes with substantial soles and good heels. Employees whose duties involve exposure to foot-injury hazards in operational areas shall not wear sandals, tennis slippers or open-toed shoes while on duty. Safety shoes with built-in steel toe-cap protection are strongly recommended.

B7. Protect your hands by wearing gloves of proper type when handling rough, splintery or sharp objects, except when operating machines with revolving spindles and cutting tools.

B8. Wear gloves while using vibrating hand tools, such as chipping guns, rivet guns, etc.

C. Protective Equipment:

C1. For certain operations special protective clothing such as rubber or slicker suits, boots, gloves, aprons, bibs and sleeves are furnished to prevent dam-

age to personal clothing and eliminate injury hazards. Your supervisor knows when special clothing is required. Consult him if you have any questions.

C2. Approved hard hats (skull guards) shall be worn by all shipyard personnel working or performing duties aboard ships, in dry docks, and in all other locations where there is danger of injury to the head.

C3. Rubber glove hand protection shall be worn when handling acids, caustics, solvents and other irritant or corrosive chemicals.

C4. Approved protective eye-wear shall be worn by all employees working in dry docks; aboard ships under repair, overhaul or construction; in posted shop areas; and when performing or passing within the dangerous vicinity of the following operations:

(a) Welding, cutting, soldering, brazing, stud-shooting.
(b) Handling molten metals, hot tars, mastics, etc.
(c) Handling or working with chemicals, solvents, caustics, etc.
(d) Handling wet-cell batteries.
(e) Grinding, power buffing or power sanding.
(f) Chipping.
(g) Wire brushing.
(h) Drilling.
(i) Caulking.
(j) Abrasive or shot-blasting.
(k) Spraying, except in exhausted booth.
(l) Glazing.
(m) Scraping.
(n) Operating power machine tools or power woodworking tools where chips or dust are present.
(o) Drop forging.
(p) Using pneumatic impact-type tools.
(q) Using striking hand-tools.
(r) Handling high vacuum electronic tubes.
(s) Doing work on overhead involving possibility of falling particles.
(t) Working under vehicles and similar operations.
(u) Working inside boiler fire-boxes and flues.
(v) Working with fiberglass, including storage areas.
(w) Using compressed air jet.
(x) Dumping operations.

(y) Any other operation where there is danger of injury to the eyes from particles, liquids or radiations, or operations designated as eye-hazardous by either the Shop Senor Civilian Supervisor or the Safety Superintendent.

C5. Corrective-protective eye-wear issued to shipyard personnel are the property of the government, and shall be turned in to the Central Tool Room upon separation or detachment, where arrangement may be made for purchase of the equipment, if desired.

C6. Keep your goggles clean. Cleaning stations are installed at tool rooms equipped with lens-wiping tissue and anti-fog compound.

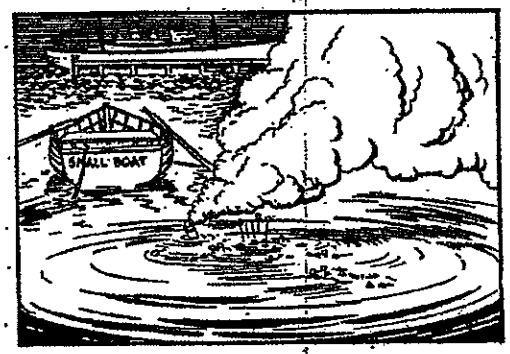
C7. Never look at or near a welding arc except through approved eye-protection equipment fitted with proper filter lenses. If required to work where exposed to either direct or reflected rays from a nearby welding arc, wear eye-protection equipment affording suitable filter lens protection and complete eye enclosure. When passing by welding operations, personnel wearing non-side-shielded spectacle type goggles shall look in opposite direction and shield exposed side of goggle with the hand.

C8. Wherever there are fumes, irritating vapors or heavy dust present in the atmosphere, respiratory equipment is

necessary for your protection. Consult your supervisor for advice on any problem that may arise. (See Section N, Rules on Personal Health.)

C9. Personnel exposed to noticeable concentrations of sand-blast dust for extended periods shall wear an approved respirator.

C10. Safety belt with properly secured life line shall be worn while working on hanging stagings and at elevations where lack of hand rail or other protection presents the hazard of falling. Always check condition of safety belts before use.



C11. Life jackets shall be worn when working in small boats or over water. (Where desired, a properly secured safety belt and life line may be substituted.)

D. Lifting and Carrying:

D1. Lift only what you are sure you can safely handle. No weight limit can practicably be set, except that imposed by common horse-sense. Use mechanical lifting devices wherever possible.

D2. When lifting, make the strong leg muscles do the work by crouching under the load and keeping the back as vertical as possible. Face the load, and keep it close to the body, lifting gradually with arms slightly bent. Don't lift from a twisted or awkward position. Firm footing and a solid grip are equally important.

D3. Keep hands and feet in such position as to protect them from being crushed if load is dropped or strikes other objects.

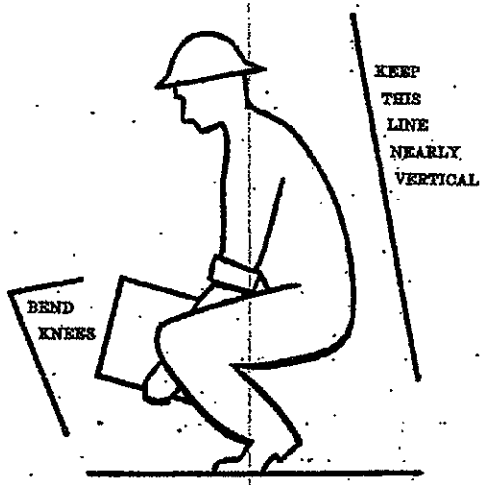
D4. When handling material with other men, all should agree on who is in charge and the signals to be given. Load should not be moved or released until all are ready.

D5. When carrying extended loads such as pipe, lumber, or ladders, keep front end high and watch carefully to avoid striking objects or other persons.

D6. If an object is too bulky to allow you to watch where you're going, it's too big to carry alone. Get help or use transporting equipment.

How to Lift:

1. You may be as strong as an ox but be careful what you lift. Even if your back muscles were made of steel there would be a limit to the strain they would stand.
2. Size up the load before you lift it. Get help if necessary.
3. Lift with your legs and not your back.



E. Housekeeping:

E1. Good housekeeping must be maintained on every job. Do your share—clean up after yourself, and do it "as you go."

E2. Keep all portable welding leads, light cords, air hoses and service lines clear of the deck or so laid as to prevent the possibility of personnel tripping over them.

E3. Never place portable leads on ladders or on the deck in front of ladders or stairways.

E4. Keep tools and materials away from edges from which they may fall on persons working below.

E5. Tool boxes allowed on board by supervisors should be placed only in designated areas, but in no case in traveled areas.

E6. In piling material or placing equipment, see that it is securely placed in a stable position to prevent falling.

E7. Oil on decks must be wiped up immediately.

E8. Keep change rooms, lockers, smoking areas, showers and toilets clean. Dispose of trash, lunch wrappings and paper towels in cans provided.

E9. Use care to place waste materials in proper containers. Separate containers shall be used for burnables, nonburnables, and oily rags.

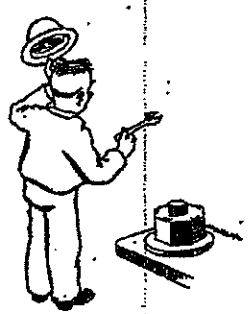
E10. Do not hang clothing, towels, rags, etc., to dry on radiators, hot lines or similar locations.

F. Hand Tools:

F1. Carefully inspect all tools before use, to determine that they are in good condition and of proper size to do the job safely.

F2. Damaged or unsuitable tools will not be permitted, whether personally or Navy owned.

F3. Never use wrenches for hammers, screw drivers or files for prys, or any tools for purposes other than intended.



F4. Do not use a piece of pipe as an extension handle on a wrench to obtain more leverage. Use a larger wrench.

F5. Use proper size and kind of wrench.

F6. Avoid wrenches with sprung, battered or worn jaws.

F7. Never shim up a wrench to make it fit.

F8. Always pull toward the adjustable jaw of a wrench.

F9. Think before pushing on a wrench. It's usually safer to pull.

F10. Get set before you pull on a wrench. Figure out what is going to happen if the wrench slips or suddenly gives, the bolt breaks, or the threads strip.

F11. Keep the surfaces and handles of tools free of excess oil or grease to prevent slipping or glancing.

F12. Never carry sharp or pointed tools loose in the pockets or loose in the tool box. Use a sheath.

F13. Soft metal, rubber or rawhide hammers only shall be used for striking hardened steel or other brittle metals.

F14. Tools with mushroomed heads or hammers with split or loose handles shall not be used until repaired.

F15. Files shall be used only when equipped with handles.

F16. Place tools not in use out of the way or in tool box or bag.

F17. Keep tools sharp. A dull tool is always hazardous.

F18. Safety goggles shall be worn when using striking hand tools.

F19. Only qualified personnel fully acquainted with Navy specifications shall be permitted to heat treat or temper striking tools.

G. Ladders and Scaffolds:

G1. Do not attempt to carry anything in the hands or under the arms while using ladders. Use a hand line for raising or lowering these objects.

G2. Ladders shall be firmly placed on secure footing. If there is danger of slipping, have ladder held by a fellow worker or lash securely. Proper angle of incline is obtained when the horizontal distance from the base of the ladder to the top support is one-quarter the length of the ladder.

G3. Portable ladders shall be of such length as to extend at least 36" beyond the top support, to provide adequate hand hold. Always face the ladder and hold on with both hands whether climbing up or down. It is generally considered safer to hold on to rungs rather than side-rails.

G4. Portable ladders shall be equipped with safety feet, except step-ladders and construction ladders firmly secured in place.

G5. Don't over-reach when working from a ladder.

G6. When necessary to place a ladder in front of a doorway, the door shall be locked or guarded.

G7. Barrels, boxes, chairs or crates shall not be used in place of step-ladders or portable steps.

G8. Ladders shall never be painted, as this may conceal dry rot or other defect. Linseed oil, clear varnish or clear lacquer form satisfactory coatings.

G9. See that ladders are stored in a safe place when not in use, secured against falling.

G10. Staging and scaffolding shall be rigged and unrigged under the direct supervision of a leadingman rigger (or, in the Public Works Department, by an authorized supervisor), who shall be responsible for the equipment and its safety. He shall detail a competent man to make a daily inspection of scaffolds, stagings and platforms.

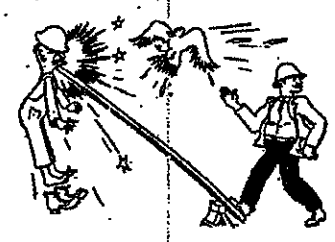
G11. Handrail protection is required on at least the outboard side of the working platforms of all scaffolds or stagings. The only exception permitted is in the case of trestle or horse stagings on which railing protection is required when built to a height of over eight feet from base.

G12. Scaffolding and staging is erected in accordance with existing standards. Do not use makeshift substitutes.

G13. The top hand rail on scaffolds and staging is required to be rigidly constructed of at least 2" x 6" lumber, or standard diameter tubular stock, at a height of 42" from platform surface. An intermediate rail or line is required to be installed at a height of 21" from platform surface, except on hanging stagings where workers are required to use a safety belt.

G14. The ends of staging or scaffold planks are painted blue where handled by Shop 72, and green where handled by Shop 07. Do not use these planks for any purpose other than for staging or scaffolds without specific permission of the responsible shop.

G15. Three plank platforms are required on scaffolds or stagings except where impossible to install. Space between planks shall be kept to a minimum.



G16. Scaffold planks should overlap at least 18", with one end over and the other end under adjoining planks.

G17. Mast stagings shall be secured against movement about the mast.

G18. Toe boards are required on all scaffolds or staging where personnel below are

likely to be exposed to injury from falling objects, except where area below is roped off and marked with warning signs.

G19. Keep scaffold and staging platforms clear of loose materials which may be jounced or knocked off onto personnel working below.

H. Machines:

H1. Unless authorized and thoroughly familiar with their use do not attempt to operate mechanical equipment such as pumps, engines, hoists, power tools and shop machinery.

H2. Gloves are very dangerous around rotating machinery. If they are authorized due to sharpness of material being handled, great care must be exercised to keep hands well away from moving machine parts.

H3. Do not wipe, clean or adjust mechanical equipment while in motion unless such operation has been approved.

H4. Where guards are removed for oiling, adjustment or repair by authorized personnel, the equipment shall be tagged out of operation, pending replacement of the guards upon completion of the work that required their removal.

H5. Never oil unguarded machinery or shafting while in motion.

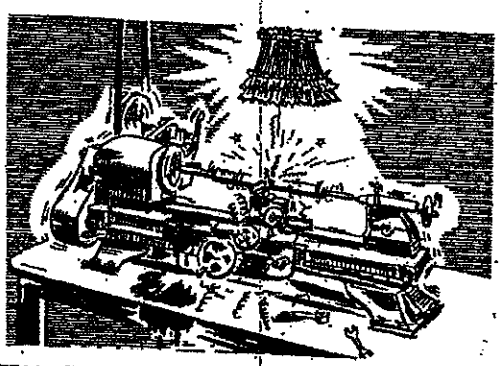
H6. Never use rags around moving machinery.

H7. Guards must be kept in place around all projecting ends of rotating machinery.

H8. Use a brush for cleaning away chips from your work.

H9. Before placing hands, head, or body beneath rams of power hammers, punches and presses, the rams must be securely blocked to prevent movement. All switches and valves supplying power must be pulled and shut off, and tagged or locked to prevent all possible danger.

H10. Employees must keep their machines clean and at the end of the shift leave them clean.



H11. Shades on machine point-of-operation

lamps shall be made of non-combustible material, so constructed as to prevent exposure of personnel to injurious or startling burns.

H12. All gears, sprockets, belts, chains, pulleys, etc., which are 7 feet or less from floor or working platform shall be guarded with approved enclosures.

H13. Do not leave your machine running unattended.

H14. Do not divert operators' attention from their work.

H15. Before starting machinery, insure that all is clear.

H16. All machining operations where dust or chips are present require the operator and those in the effective vicinity to wear approved eye-protection.

H17. Tool rests, guards, tongues and shields shall not be removed from abrasive wheels. Work rest clearance shall not exceed 1/16".

H18. Avoid forcing work against a cold wheel; apply pressure gradually, giving the wheel a chance to warm up.

H19. Take care not to strike an abrasive wheel at any time, except where making authorized tests.

H20. Speed of abrasive wheel shall not exceed that prescribed by the manufacturer.

H21. Report immediately any abrasive wheel which shows evidence of injury or excessive vibration.

H22. Operators of abrasive wheels and personnel in the dangerous vicinity shall wear approved eye-protection.

H23. Use extreme care reaching around rotating parts of drill presses, lathes, boring mills, etc. If hair is long, wear a cap.

H24. Never attempt to hold the work on a drill press table; clamp it securely in place.

H25. Run machine drills only at proper speed; forcing or feeding too fast may result in a broken drill and serious injury.

H26. Long drills of small diameter may bend and whip out if run too fast. Keep speed and feed at a minimum.

H27. When operating power saws use push-stick wherever possible.

H28. Kick-backs from power saws can be fatal. Always stand out of line with the saw, use splitter or non kick-back fingers wherever possible, never bring a piece of wood down on top of a saw and keep saw table cleared of cut-off pieces.

H29. Keep the floors around all power woodworking machinery scrupulously clean. A slip or stumble can be serious.

H30. When operating jointers, always push stock through, using pusher block wherever possible. Always take a shallow cut and feed slowly. Keep cutter guard in good working order.

H31. When operating a band saw, keep the guide adjusted to a small clearance from the material being sawed and avoid any cut which tends to bind the blade.

H32. A depth collar shall be used on shaper operations wherever possible.

H33. Always check security of shaper cutters prior to starting up. Do not leave shaper running unattended.

H34. Wear approved eye-protection when working on or in effective vicinity of power woodworking operations.

H35. Inspect all portable power tools before use. Make sure extension cord and attachment plug of electrical tools are in good condition, and frame ground-wire connected.

H36. No power tool of any description shall be raised or lowered to or from decks or staging by the air hose or power cable.

H37. Never lay a portable power-tool down while still running. Disconnect power source if leaving, to prevent accidental tripping of control switch or trigger.

H38. Portable power abrasive wheels, disc sanders and wire brushes shall not be used without adequate guards. Whenever other persons must remain in the vicinity of such operations, a portable shield shall be used.

H39. Approved eye-protection shall be worn by operators of all pneumatic impact-type tools and by personnel in the effective vicinity.

I. Electricity:

I1. Only authorized persons shall make repairs to or work on electrical equipment. Securing regulations shall be observed.

I2. All electrical wires must be considered live until proven they are not.

I3. Steam, water or oil leaks near electrical equipment shall be reported immediately to the supervisor in charge.

I4. Working surfaces shall be kept dry when working with, or near, electrical apparatus.

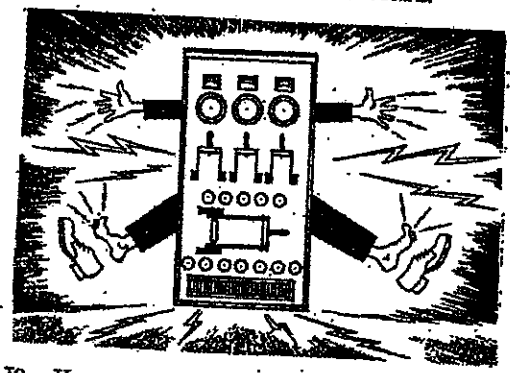
I5. The frames of all portable electrical equipment shall be grounded when in operation.

I6. No equipment or machinery shall be operated at less than six (6) feet from any high tension power line.

I7. A switch shall not be closed without full knowledge as to why the circuit is

open. The tag on the switch shall be removed only by the person who tagged the switch open. See Rule A21.

I8. Material or gear shall not be hung on switchboards or left near enough to obstruct ready access to the board.



I9. Keep out from behind power panels aboard ship unless authorized to enter.

J. Safe Clearance:

J1. Material, equipment or fixtures shall not be placed alongside railroad or crane tracks closer than 4 feet 8 inches from the outside rail.

J2. Passageways, walks, entrances, exits, access to utility controls, or other areas designated by floor striping shall not be blocked by temporary or permanent

placement or storage of material or equipment.

J3. In removing pipe, tubes or similar materials, avoid standing in front of the pile.

J4. Do not stand under or between skids or timbers while handling material. Make sure skids or timbers are securely placed and sufficiently strong for the load.

J5. Never walk or stand under suspended loads. Stand well to the side and clear.

J6. Do not stand in the bight of a line.

J7. Place red flags or flares on materials projecting into passageways, or from trucks or flat cars.

K. Compressed Air:

K1. Use compressed air only when and as directed by your supervisor.

K2. When compressed air is used for applying pressure to closed containers, always provide proper pressure relieving devices.

K3. A stream of compressed air shall never be directed at any part of your or other employee's body.

K4. When using a stream of compressed air for any authorized purpose, protect your eyes with safety goggles and see that personnel in the vicinity are not endangered.

K5. Always shut off air at manifold and bleed air hose before disconnecting tool or air hose.

K6. Compressed air shall not be used to force oil from drums. Use gravity flow or hand pump.

L. Traffic:

L1. Keep on the alert while walking in the yard. Use marked walks and crosswalks where provided, and observe all warning signs and signals. Always look both ways before stepping into roadways.

L2. Pedestrians in designated walkways have the right-of-way over all vehicles, except those on an emergency mission.

L3. All persons riding bicycles, choreboys or scooters must obey traffic rules in regard to riding on the right side of the road or traveled area. Use hand signals well in advance of the turn, and do not pass any vehicle on the right.

L4. Carrying other persons or material on the handle bar or frame of bicycles is prohibited.

L5. Do not ride a bicycle at night unless it is equipped with head light, and tail light or reflector.

L6. Bicycle riders shall not ride abreast of each other.

L7. Bicycles shall not be ridden on sidewalks or in buildings.

L8. Persons crossing caissons on bicycles shall dismount and push the bicycle across.

L9. Bicycles shall be turned in monthly to Shop 02 for check and overhaul.

L10. Do not operate a government owned vehicle without proper authority. Operators of all motor vehicles, including motorcycles, scooters, and cranes mounted on conventional truck chassis, shall have on their person a valid U. S. Navy Operator's Permit while driving.

L11. The traffic laws of the State of Washington apply within the yard. Observe posted speed limits.

L12. Persons holding permits to park on piers and in other non-assigned areas shall take precautions to park clear of general traffic, cranes and railroad tracks.

L13. Riding in truck bodies is prohibited unless the truck is fitted with seats or with special hand-holds over the rear of the cab.

L14. When riding in truck bodies, remain seated or maintain a firm grip on handholds.

L15. When any motor vehicle is in motion, riders shall not board or leave, ride on running boards or steps, or permit legs or arms to dangle over the side.

L16. Emergency vehicles have the right-of-way upon sounding siren and flashing red warning light. All vehicles shall immediately pull clear of the roadway and stop until emergency vehicles have passed, regardless of direction travelled.

L17. No more than two persons shall ride in the cab of any truck except where the truck is labeled suitable for three persons.

L18. Jeeps shall not carry more than driver and one passenger in the front seat.

L19. Because of their light weight and high center of gravity, scooters, choreboys and similar vehicles shall be operated with extreme caution and all regulations governing the operation of motor vehicles shall be observed in their operation.

L20. Do not ride tandem on scooters.

L21. Do not use scooter side cars for carrying passengers except where specially constructed for the purpose.

L22. Passengers riding on choreboys or similar vehicles is prohibited.

M. Fire:

M1. Make it a habit to know the location of and proper use of the nearest fire-fighting and fire alarm equipment wherever you are working. When notifying Fire Department by telephone, call 222.

M2. There are four types of fire extinguishing mediums provided in the shipyard, with which all employees should be familiar:

a. CO_2: For use on any fire.

b. Soda-acid: For use on rubbish and other combustible materials (never on inflammable liquids or electrical fires).

c. Water Pump Cans: Same as b. above.

d. Pyrene (carbon tetrachloride): For use on electrical fires, around motors, etc.

M3. When using fire extinguishers direct the stream at the base of the fire for most effective extinguishing action.

M4. CO_2 gas is asphyxiating, and carbon tetrachloride, a toxic liquid, forms poisonous phosgene gas upon contact with heat. Employees shall stand clear of confined spaces in which a fire is being extinguished with these chemicals, and shall not enter such space after the fire is out until space has been adequately ventilated.

M5. Fire-fighting equipment shall not be used for any other purpose.

M6. All fire-fighting equipment shall be kept unobstructed at all times.

M7. "Strike anywhere" or non-safety matches are not permitted in the shipyard. To be sure match is out, break it before throwing away.

M8. Keep covers on inflammable liquids, store in approved fire resistant ventilated cabinets when not in use.

M9. Gasoline shall not be used for cleaning purposes.

M10. Gasoline shall be transported and stored in safety containers only.

M11. Vapor-proof lights shall be used in the vicinity of gasoline or other inflammable or gaseous vapors.

M12. Do not throw paint or oil-soaked rags or clothing into piles. Spontaneous combustion may result. Place in proper covered receptacles and remove at the end of the shift.

M13. Observe all posted signs prohibiting smoking or heat producing operations. When you use temporary warning signs see that they are removed when no longer needed.

M14. At quitting time supervisors will have work areas inspected for fire hazards and eliminate where observed.

N. Personal Health:

N1. Report any illness to your supervisor who will send you to the Dispensary.

N2. Coughing and sneezing spread disease; use a handkerchief. Spitting on decks of shops, ships and sidewalks is forbidden.

N3. Do not breathe fumes from welding, burning, cutting, plating, pickling, painting, lead burning, galvanizing, molten metals and other fume producing operations. Where adequate ventilation is not procurable, use fume type or air-fed respirators.

N4. Wear dust type or air-fed respirators for chipping red lead, handling amosite or insulating materials, while dressing abrasive wheels, while working exposed to dust from sand blast operations (wet or dry), and for any other dusty processes where effective ventilation cannot be obtained.

N5. During hot weather or while doing hot work, drink plenty of water and eat salt tablets to prevent heat cramps or prostration.

N6. Fluorescent lamps contain chemicals which can seriously retard healing of skin abrasions, and are dangerous to breathe. Therefore, fluorescent lamps shall be handled only by authorized personnel of Shop 07 (ashore) and Shop 51 (afloat).

N7. Keep your skin healthy. Various protective-barrier skin creams are provided for protection against unavoidable contact with chemical and mechanical skin irritants, such as oils, paints, solvents, etc. Your supervisor or toolroom attendent will advise you regarding proper types and applications. Remember that your best insurance against development of industrial and most other skin diseases is to avoid contact with skin irritants as far as possible through the use of proper protective equipment, coupled with observation of a high standard of personal hygiene.

O. What To Do in Case of Injury:

a. All employees receiving injury while at work shall report to the Shipyard

Industrial Dispensary immediately for treatment. Prior to leaving the job, however, Dispensary Permit Form NAVEXOS 107 shall be obtained from the immediate supervisor, or if this is not practicable, from any other supervisor or from the shop office.

b. The injured employee shall retain the original of the Dispensary Permit until conclusion of treatment for the injury, presenting it to the Industrial Dispensary and supervisor for required entry of dates treated and all times of departure from job, arrival at Dispensary, return to job, etc. Upon termination of treatment the original form shall be forwarded to the Safety Division via the immediate supervisor.

c. In case of serious injury to civilian employees, call 496 (Industrial Dispensary) for ambulance. Where military personnel receive serious injury, call 604 (Naval Dispensary).

d. Remember, every injury known or suspected to have occurred on the job must be reported for treatment immediately, no matter how trivial it may appear to you.

P. Employees' Compensation:

a. All civil employees of the United States who are injured while in the performance of duty are entitled to

medical care and compensation for disability, under a program administered by the Federal Security Agency, Bureau of Employees' Compensation, Washington, D. C. The Safety Division, Industrial Relations Department, is charged with the responsibility of processing all claims arising from occupational injury, and will see that you receive fair and adequate treatment in case you are injured while at work.

b. Immediately upon reporting an injury to the Dispensary, the injured employee will be assisted in the preparation of an official Notice of Injury form, which provides the basis for any claim for disability compensation or medical treatment which may become necessary. It is of extreme importance that this notice be properly executed within 48 hours after the occurrence of an accident, since failure to do so may result in refusal of benefits.

c. Under the provisions of the Federal Employees' Compensation Act, revised 14 October 1949, employees disabled as a result of injury sustained in the course of their work are, in addition to medical and hospital care, entitled to compensation at the rate of 66 2/3% of the pay received at the time of injury, plus an extra 8 1/3% if employee has a dependent, up to a maximum compensation of $525 per month.

d. Compensation starts on the fourth day after the employee's pay stops. The worker has the right to elect to receive sick or annual leave or compensation, or any combination of these, for the period of disability. If the period of disability lasts over 21 days, a retroactive payment will be made to cover the 3-day waiting period.

e. In cases involving permanent partial disability, including loss of or loss of use of fingers, hands, arms, toes, feet, legs, vision or hearing, scheduled awards ranging from 15 weeks compensation for loss of a little finger to 312 weeks for loss of an arm are payable in addition to compensation received during the healing period. Payments up to $3500 may also be made in cases involving disfigurement.

f. In cases involving death, incurred as a result of accidents occurring in line of duty, burial payments are authorized up to $400, and payments are provided for widows, dependent widowers, dependent children and other dependents. Further information on this or other phases of the Employees' Compensation Act may be obtained from the Safety Division by request.

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Exhibit 16

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION

all to whom these presents shall come. Greeting:

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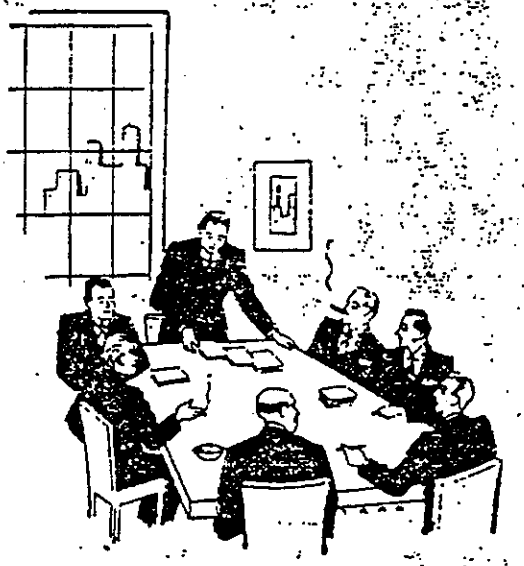


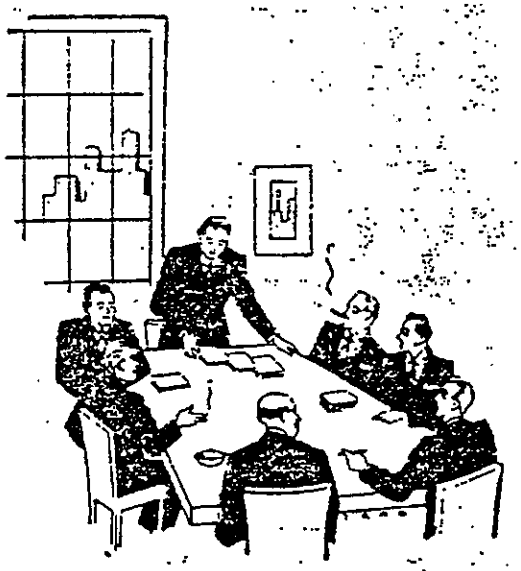
BOSTON NAVAL SHIPYARD

8-9-10 MAY 1957

DEFENDENT'S EXHIBIT
Buffalo Pumps
96

PIPE AND COPPER SHOP
MASTER MECHANICS' CONFERENCE

MINUTES



BOSTON NAVAL SHIPYARD

8-9-10 MAY 1957

PERSONNEL WHO WILL PARTICIPATE IN THE
FIRST SHIP 56 MASTERS' CONFERENCE
TO BE HELD 6-9-10 MAY 1957 AT
BOSTON NAVAL SHIPYARD

BOSTON NAVAL SHIPYARD

Rear Admiral W. Z. Howard, Jr., USN	Commander, BNE
Captain J. E. Flynn, USN	Production Officer
Commander C. L. Daniel, USN	Shop Superintendent
Mr. G. P. Chamberlain	Master, Shop 56
Mr. A. D. Sproul	Foreman, Shop 56
Mr. L. E. Carley	Production Analysis Assistant

BUREAU OF SHIPS

Commander H. M. Simpson, USN	Code 550, Gas Turbines
Mr. E. B. Stecher	Code 540, Mach. Arrgt. & Piping S

CHARLESTON NAVAL SHIPYARD

Mr. H. E. Miller, Jr.	Master, Shop 56
Mr. C. W. Edwards	Chief Quarterman, Shop 56

LONG BEACH NAVAL SHIPYARD

Mr. O. W. Meeker	Master, Shop 56

MARE ISLAND NAVAL SHIPYARD

Mr. I. N. Whitthorne	Master, Shop 56

NEW YORK NAVAL SHIPYARD

Mr. L. W. Ferris	Master, Shop 56

NORFOLK NAVAL SHIPYARD

Mr. R. L. Lucas	Master, Shop 56

PEARL HARBOR NAVAL SHIPYARD

Mr. L. H. Atkinson	Master, Shop 56
Mr. J. H. Williamson	Quarterman, Shop 56

PHILADELPHIA NAVAL SHIPYARD	
Mr. C. J. Bastian	Master, Shop 56
Mr. M. Endres	Chief Quarterman, Shop 56
PORTSMOUTH NAVAL SHIPYARD	
Mr. E. H. Lord	Master, Shop 56
PUGET SOUND NAVAL SHIPYARD	
Mr. C. M. Richards	Foreman, Shop 56
SAN DIEGO NAVAL REPAIR FACILITY	
Mr. T. N. Carr	Foreman Mechanic
Mr. J. E. Yates	Chief Quarterman, Shop 56
SAN FRANCISCO NAVAL SHIPYARD	
Mr. F. C. Winslow	Master, Shop 56
Mr. M. Pogliomich	Senior Analyst and Scheduler, Shop 56

AGENDA

Conference

of

U. S. Naval Shipyard, Pipe & Copper Shop, Master Mechanics

Boston Naval Shipyard

Boston, Mass.

May 8, 9, 10, 1957

Wednesday - 8 May

0815-0900 Registration and Assembly
Pipe & Copper Shop Conference Room
Building #195 - 2nd Floor

0900-1000 Conference Opening

Commander C.L. Daniel, USN
Shop Superintendent

Welcoming Remarks

Rear Admiral W. E. Howard, Jr., USN
Shipyard Commander

Introduction of Conference Chairman

Captain J. E. Flynn, USN
Production Officer

Formal Opening of Conference

Mr. George P. Chamberlain
Master Pipefitter & Coppersmith

1000-1015 Recess - Group Photo outside Door #3 - Weather permitting

1015-1100 Presentation of a paper on
"Production Planning & Control"
by Mr. Lyman E. Carlow
Production Analysis
Boston Naval Shipyard

Wednesday - 8 May (Continued)

1100-1145 Presentation of a paper on "Job Standards" by Mr. C. J. Bastian Philadelphia Naval Shipyard

1200-1300 Lunch - Officers' Club

1315-1400 Presentation of a paper on "Material Scheduling and Handling" by Mr. H. E. Lucas Norfolk Naval Shipyard

1400-1445 Presentation of a paper on "Piping Identification & Control" by Mr. E. H. Lord Portsmouth Naval Shipyard

1445-1500 Recess

1500-1545 Presentation of a paper on "Fabrication and Processing of Alloy Piping for High Temperature High Pressure steam" by Conference Chairman, Mr. G. P. Chamberlain Boston Naval Shipyard

1545-1630 Presentation of a paper on "On-the-job training for Pipe & Copper Shop Personnel as related to New and Improved Techniques and Safe Practices" by U. S. Naval Repair Facility Representative Mr. T. M. Carr

Thursday - 9 May

0815-0900	Presentation of a paper on "The Effective and Uniform Use of Current Navy Piping Specifications and Standards" By Mr. F. C. Winslow San Francisco Naval Shipyard
0900-0945	Presentation of a paper on "Simplification of Design and Fabrication as Related to Pipe Fabrication" by Mr. L. H. Atkinson Pearl Harbor Naval Shipyard
0945-1000	Recess
1000-1045	Presentation of a paper on Effective Shop Layout" by Mr. L. W. Ferris New York Naval Shipyard
1045-1130	Presentation of a paper on "Pipe Fabricating Techniques in Industry" by Mr. C. M. Richards Puget Sound Naval Shipyard
1130-1230	Lunch - Officers' Club
1230-1630	Demonstrations or Displays by Aluminum Company of America Armstrong Cork Company Crane Company Duralith Corporation F. N. Eastman Company Grinnell Company Henry Valve Company Barry Hyman Company G. B. Lewis Company Liquidometer Corporation Nelson Stud Welding Company Parker Appliance Company Taylor Forge and Pipe Company Tube Turns Tubular Structures Corporation of American Wallace Supplies Manufacturing Company Walworth Company Yarnall-Waring Company

Friday - 10 May

0815-0900 Presentation of a paper on "The Effect of Gas Turbine Propulsion on the Piping Industry" by Bureau of Ships' Representative Commander H. M. Simpson, USN

0900-0945 Presentation of a paper on "Refrigeration and Air Conditioning Systems" by H. E. Miller, Jr. Charleston Naval Shipyard

0945-1000 Recess

1000-1045 Presentation of a paper on "Piping Problems in Nuclear Power Plants" by Mr. I. H. Witthorne Mare Island Naval Shipyard

1045-1130 Presentation of a paper on "Uses and Limitations of Plastic Pipe and Tubing" by Bureau of Ships' Representative Mr. E. B. Stecher

1130-1215 Presentation of a paper on "Pipe Insulation Processes and Procedures" by Mr. O. W. Ireland Long Beach Naval Shipyard

1215-1315 Lunch - Officers' Club

1315-1500 Review - Discussion - Summation

Mr. G. P. Chamberlain

1500-1515 Remarks Captain J. E. Flynn, USN Production Officer

1515-1530 Formal Closing of Conference Rear Admiral W. E. Howard, Jr., USN Shipyard Commander

Pipe and Copper Shop
Master Mechanics' Conference
Boston Naval Shipyard
8, 9, and 10 May 1957

Wednesday, 8 May 1957

0815 - 1200

AGENDA

WEDNESDAY 8 MAY 1957

0815-0900 Registration and Assembly
Pipe & Copper Shop Conference Room
Building 195, 2nd Deck

0900-1000 Conference Opening - Commander C. L. Daniel, USN
Shop Superintendent - Conference Chairman (Pro-Tem)

Welcoming Remarks
RAdm. W. E. Howard, Jr., USN - Shipyard Commander
Captain J. E. Flynn, USN - Production Officer

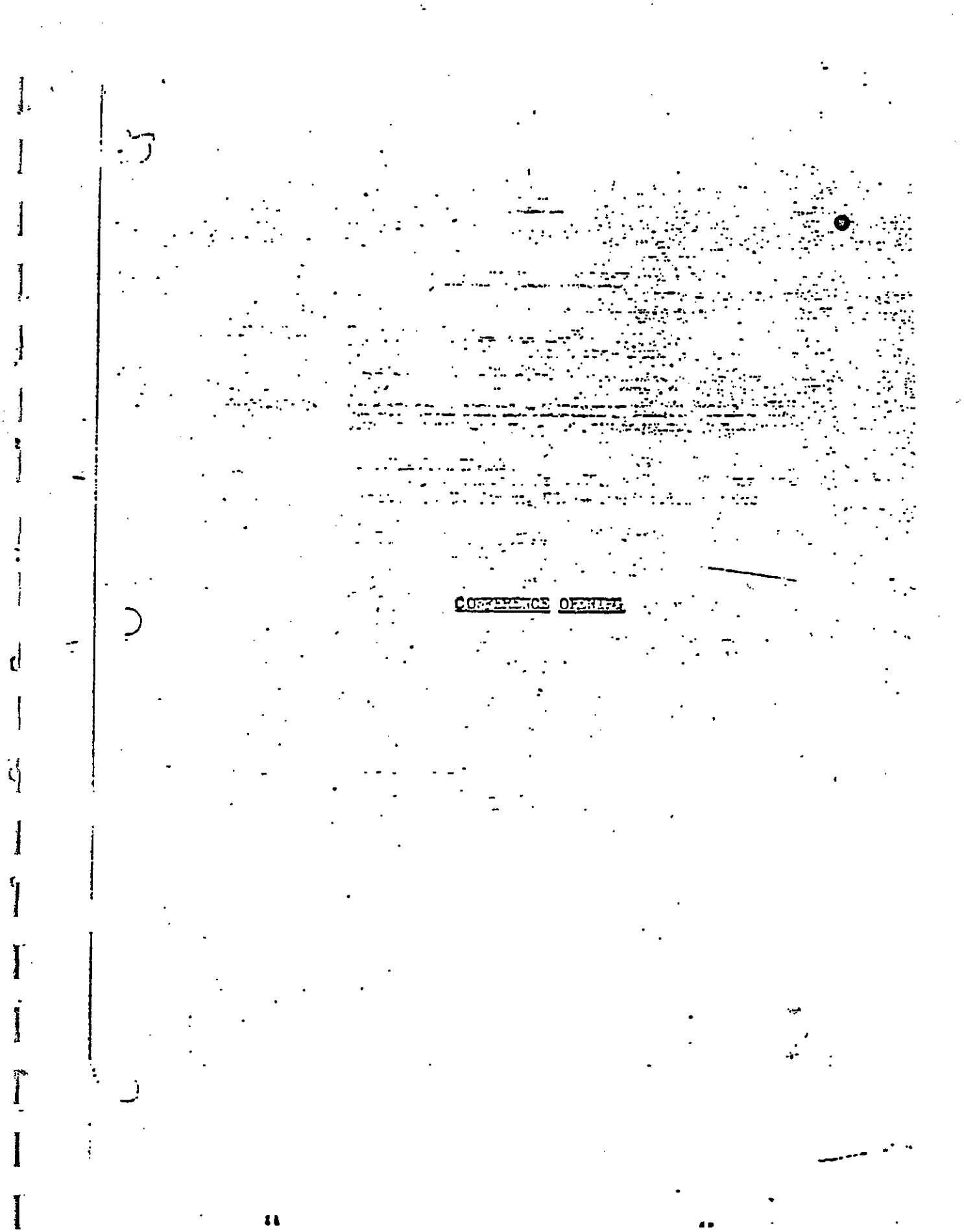
Introduction of Permanent Chairman
Captain J. E. Flynn, USN

Address By Permanent Chairman
Mr. George P. Chamberlain, Master Pipefitter & Coppersmith
Boston Naval Shipyard

1000-1100 "Production Planning and Control"
Mr. L. E. Carlow, Production Analysis Assistant
Boston Naval Shipyard

Discussion of preceding presentation

1100-1200 "Job Standards"
Mr. C. J. Bastian - Master Pipefitter & Coppersmith
Philadelphia Naval Shipyard


CONFERENCE OPENED

Commander C. L. Daniel:

Admiral Howard, Captain Flynn, Representatives from the Bureau of Ships, Lady, and Gentlemen of the Conference:

I hereby declare the Pipe and Copper Shop Master Mechanics' Conference to be opened.

It gives me an unusual amount of pleasure to meet you and welcome you to the Boston Naval Shipyard.

I have just returned from Philadelphia where I attended the first part of the Tool Conference, where I learned at first hand the immense amount of value these conferences can be. With the wealth of talent and experience in you people assembled here; with your free exchange of ideas, and with the fellowship of your meeting together for the next three days, I hope, and I sincerely believe, that you will all leave here having gained a great deal from this Conference.

(COMMANDER C.L. DANIEL:)

We have the honor of having Rear Admiral William E. Howard, Jr., our Shipyard Commander, address you at this time. I now present Admiral Howard:-

(REAR ADMIRAL W.E.HOWARD,JR.:)

Gentlemen:

Welcome to the Boston Naval Shipyard and to Boston. Former Assistant Secretary Pratt once stated that, at this particular time of the day, remarks should Be brief, Be gay, and Be gone. I propose the former and latter - I don't propose at this particular time to be gay.

I do want to say this, that conferences of this type were discussed at the last Shipyard Commanders' Conference and procedures for them were set up. However, over a year ago we stuck out our necks and asked for this conference and asked that it be held here, and we are very happy to be your host.

I feel a great deal of time and preparation has gone into this, from a preliminary point of view, and I also think and hope that those of you from near and far who have prepared papers have not only done your part of it, but have had the opportunity to read the others so that the time here can be as fruitful as possible by a discussion of these papers and of other matters.

There is one item I do want to mention - COSTS. I do not know how it is in the Pacific Area, but here in the Atlantic Area money is tight. However, our repair costs are level this fiscal year with the previous one. This is the first time there has not been a rise year by year. This does not mean that we are in a satisfactory position, but it does mean that the tide has been stemmed. On the other hand, with the trend of rising costs, we have had to bend all efforts possible to do more for our customers for the same amount of funds. Now, Production Planning and Control is an effort in that direction. Improved methods, better coordination in and between trades must offset the steadily rising costs.

It is my hope that the cost of this conference, which is not inconsiderable, will be repaid a thousandfold by that develops from it.

Thank you, gentlemen, and welcome!

(COMMANDER C.L. DANIEL:)

Thank you, Admiral Howard.

(COMMANDER C.L. DANIEL:)

It is now my pleasure to present Captain J. E. Flynn, our Production Officer. Captain Flynn.

(CAPTAIN J.E. FLYNN:)

Gentlemen:

I want to add my welcome to that expressed by Admiral Howard. There is nothing to add to that, for he left nothing unsaid.

I asked to be here especially because among the conferees I see many friends of former years. I am an alumnus of several of the Shipyards represented here. If I have not been brought up properly, it is possibly your fault.

Among other things, I am happy about the weather, at least for today. Only last Sunday I put my snow shovel away in the cellar, so I want you to understand that practically anything can happen in Boston.

I do have a couple of suggestions to offer to the Chairman, although he is perfectly free to do as he chooses. We asked you to make your presentations as brief as possible so that we will not have to go through the dry reading of the full subject when you make your presentation. The purpose of that request is to allow time for considerable discussion after a topic has been presented, and I think that is the greatest benefit to be derived from a conference. It is the discussion that produces the fruit, and I suggest that you run this conference with an eye on the clock, for by the time Friday afternoon rolls around you are going to discover that you need more of that precious commodity - TIME. In addition, each discussion is likely to provoke new topics - and some might even develop into a bull session. For example, it is important that you allow yourselves an executive session - and, while the conference agenda doesn't specify an allotted time for that, I think you might give some thought to a round table discussion - which I predict will last for four or five hours. You will find that you are going to want an uninterrupted period of four or five hours, which may perhaps be worked into the program on Thursday afternoon, or maybe Friday afternoon.

It is your conference - it is not ours. We, as Admiral Howard said, are your hosts.

If you find any inadequacy and you will make the deficiency known, I will be only too happy to step in and do whatever I can to help. Our attitude here is that we feel honored to have the Master Mechanics from the Pipe and Copper Shops here in Boston, and we want them to enjoy a successful conference. It is our obligation and we are prepared to live up to it.

(Captain J. E. Flynn) I want to introduce to you at this time the Chairman of this Conference Mr. George Chamberlain, Master Pipefitter and Coppersmith here in Boston.

FORMAL OPENING OF CONFERENCE
By G. P. Chamberlain

Admiral Howard, Captain Flynn, Commander Daniel and fellow conferees. I accept the Chairmanship of the first Pipe and Copper Shop Master Mechanics' Conference with pride, but also with a sense of humility. I realize well, the responsibilities and importance of this position and cherish the opportunity to serve.

The purpose of this Conference is to provide a common meeting ground for the identification, discussion and resolution of problems common to all U. S. Naval Shipyard Pipe and Copper Shops.

During these past few years, we in this United States of America, have been taught to regard ourselves as the chosen people of the God of material industrialization.

There has been painted for us a panorama of resplendent prosperity. We marvel at the prodigious accumulation of wealth. We rejoice in the multiplication of labor saving devices, whose main purpose and object is to lift the burden of labor from the hands of weary men.

America, in its short industrial life of 150 some odd years, has witnessed more material progress than has Asia in the past 150 centuries. We are presently witnessing the unfolding of new sources of power, atomic energy, and the efforts to harness that tremendous energy, for the benefit of industry. We see jet engines, capable of driving airliners at a speed of 600 mph, electronic machines which are almost capable of thinking, rocket missiles with a 3000 mile range, wonder drugs that save lives that would have been lost only a few short years ago, and feats of medicine and surgery that border on the miraculous are performed with new equipment which is the product of our industries. Great turbine engines produce power greater than all men and all beasts of burden on th earth combined. Mammoth shafts and mighty anchors, motor cars and miles of super highway for them to ride upon. All of these are fabricated, manufactured and accomplished with a speed and a quantity almost unbelievable. As a matter of fact, the United States is capable of supplying two thirds of the machined products of the entire world. These are no dreams of tomorrow, but actual reports of projects now underway, that are helping to make a new and wonderful world.

It is not my purpose to review for you any further, this epic of American progress. Each of these developments and dozens more like them are now part of the program of the Navy. We, as part of Navy production management, are a vital part of this program. We have an opportunity in this dynamic parade of events, which few people are privileged to have in their lifetime.

Some of the major advances in science, when put to practical uses, require a tremendously expanded use of piping. In other words, the normal growth of scientific knowledge has in and of itself, created a demand for an even greater number of qualified people in the pipefitting field. New production methods are being rushed into use, under the stimulus of this Nation's efforts to defend itself. In this mad rush for efficiency and production, there has been scarcely time to perfect the

proper procedures, the painstaking step by step measures which must be followed in the fabrication of the piping systems which are so important in the control of our great sources of power. We are in a unique primary position in the field of piping for Naval power. Prime is defined in Funk and Wagnall's dictionary as: "The Beginning of Anything." We as prime movers in the field of Naval piping, find ourselves this morning, sitting in conference at the beginning of what promises to be the greatest era in the piping industry. We are being given a special opportunity to become the undisputed leaders in the field of marine piping. We want to be efficient. We want clear thinking and fearless action along the right lines of thought. Our program must be sound and workable. Experience has shown that these conferences alone can not ensure success. We need the unwavering support of all segments of management within our own industry. We need reassuring assistance of all related departments, free from petty considerations. Our problems are serious enough to merit constructive action. That, we have the right to expect.

If the United States Navy is to continue guarding jealously, its standing in the world of today, as a hard hitting military organization of the highest calibre, then it must continue to develop still newer methods of production.

Since our purpose is so worthwhile, I am confident as to what the outcome of this conference will be. We recognize our wider frontiers and wider responsibilities. We accept that responsibility and the challenge of the future. Dedication can scarcely be considered complete, unless it includes devotion to the work of bringing increased contribution and efforts to meet this challenge. My congratulations go to you and may we be enormously successful.

(MR. G. P. CHAMBERLAIN:)

Gentlemen:

At this time, in the absence of Mr. Chet Stanton, the President of our local Master Mechanics and Foreman's Association, who is attending the 61st Annual American Foundryman's Society Congress at Cincinnati this week, I have the pleasure of introducing to you, Mr. David Himmelfarb, Master Ropemaker, who is undoubtedly known to some of you as a National Committee-man of the Master Mechanics and Foremen's National Association. Mr. Himmelfarb!

(MR. D. HIMMELFARB:)

Mr. Chairman, Admiral Howard, Captain Flynn, Commander Daniel, my Fellow Master Mechanics, and invited guests:

On behalf of the Boston Local Chapter of the Master Mechanics and Foremen's Association, it is my privilege to bring our greetings to this conference.

I have been instructed by your Fellow Master Mechanics to convey our best wishes. It is our sincere effort to try to make this conference a 100% success. If there is anything that we can do as individuals or collectively to further the success of this conference, please pass the word.

I would like for a moment to deal with the position of Master Mechanics in the Naval Shipyards. All of us, from time to time, feel we are being engulfed by new and changing staff functions. We see new faces, new groups - all of which are presumably designed to help in the achievement of our industrial mission. We note increasing overhead expenses and see no relief from mounting costs. Engulfed by all of this, we often despair that not only is our effectiveness being threatened, but our positions as Master Mechanics are being weakened - if not actually threatened.

Gentlemen, let me assure you that there is nothing further from the truth in this type of thinking. Every time we have a doubt in our Shipyard as to our status as leaders of the industrial operations, our Shipyard Commander dispels it; our Production Officer dispels it, and I can assure you that your respective Shipyard Commanders and your Production Officers will dispel it, too. In our meetings at the National Association level, our conference members are aware that Bureau Chiefs are concerned with civilian industrial operations also. If we needed any more evidence, there is the fact that the Navy recognizes it by encouraging conferences such as this.

(MR. G. P. CHAMBERLAIN:)

Gentlemen:

Now to open the business of the conference, I am going to present a man whom we in Boston think is particularly qualified to discuss the problems of Pipe and Copper Shops, as they become embroiled with the Production Planning and Control Program. Having been a Master Pipefitter and Coppersmith for seven years, he understands our particular problems best.

It is accepted as fact that only about one in twenty American adults have ever been exposed to a formal course in economics. Yet the great issues of the day are interwoven with an economic base. Lacking knowledge of economics, any individual falls prey easily to the something-for-nothing philosophy. Lacking knowledge of how a business operates, a person might readily believe that profits, and the profit motive, are forces for evil rather than forces for good.

This gentleman whom I am about to introduce to you a few short months ago stepped into a job which was considered by many as an impossible one. He has stimulated sound thinking and attitudes about the spirit and workings of our Production Planning and Control System. He has developed a better understanding of the workings of the system. He has improved attitudes which were based on popular misconceptions and mistaken economic beliefs.

I give you Mr. Lyman E. Carlow, Production Analysis Assistant, and my predecessor as Master Pipefitter and Coppersmith at the Boston Naval Shipyard.

Mr. Chamberlain: Thank you, Mr. Atkinson.

Mr. Ferris of the New York Naval Shipyard will speak to us on "ELECTRICAL SHOP LAYOUT."

"Effective Shop Layout"

Mr. L. W. Ferris
New York Naval Shipyard

"Effective Shop Layout"

Introduction:

Gentlemen, when I was first informed that the topic assigned to me was to be "Effective shop layout" I said to myself "what the devil" everyone there has had a lifetime of experience on that subject and each one has his own opinion. There is no doubt in my mind that every Master Mechanic here thinks as shops go, along the lines of the flea who thinks his dog is the best damn dog in the world. At this point I suppose I should sit down and forget the whole thing and maybe some of the members present wish I would. However, having been asked to present a paper, I am going to proceed along that line. The title "effective shop layout" may be interpreted in several ways, such as proper set up of machines and equipment for the most efficient manner of performing the work within a structure which was originally designed for some other purpose, or a proper set up of modern machines and equipment within a structure designed particularly for the purpose. The former interpretation is the one we have lived with and have changed each time a new development of our work takes place.

The old shop of twenty years ago was devoid of stress relieving, welding, X Ray, bending machines, pipe identification equipment and etc. So we changed from expanding and spelter brazing to van-stoning and then from van-stoning to welding. With the advent of the new higher steam pressures more changes were made and there is no question in my mind that changes will have to be made to fit in with the new age upon which we are about to embark, that of Nuclear Power. This brings me back to the title "Effective Shop Layout", is it something you make the best of, with what you have or is it something you devise using building, equipment and machines best suited, a sort of "ideal shop."

Many of us have dreamed of what we would ask for if given the opportunity and here there would be a large number of opinions, not all alike for the opinions would be based on the type of work performed at that person's yard. There is one thing I am sure, each one of us would base our ideal shop on the shortcomings of our present shop. So with this in mind, I will endeavor in the time allotted me, to describe the layout of the ideal shop, designed specifically to operate as a Pipe and Copper Shop. Theoretically there would be no problems of space or money. After laying out our ideal shop, will describe how our present shop is arranged to conform with this layout as far as the terminal size and space permits.

As I see it, the shop is a shell which contains our men and machines. This shell should be so planned, designed and built that it not only amply provides for present requirements, but it must be able to accomodate, with utmost efficiency the inevitable increase in shop personnel, internal transportation and particularly, in the number and size of new machines for the next ten years. This is by no means a purely visionary idea, but is predicated on the tremendous strides and multitude of technological developments in the field of marine engineering since World War II. In addition we must not lose track of the fact that Navy Yards and shops operate at approximately 10% of their potential in peace time. The shop must be designed to operate efficiently at the lower figure and able to expand to the maximum in time of emergency.

As I stated before my talk will consist of:

1. The layout of the Ideal Shop (which includes)
    a. Process method layout
    b. Kind of Building
    c. Receiving and Storage
    d. Transportation
    e. Functional layout
    f. Tools and Toolroom
    g. Personnel Accomodations
2. How Present Shop conforms to "Ideal"
    a. General Areas
    b. Functional Arrangement
    c. Copper Shop
    d. Shipping Department
3. Conclusion

1. LAYOUT OF THE "IDEAL SHOP"

a. Process Method Layout

Effective shop layout considers the function of the shop, quantity of production, type of production and type of operations involved. Since our work consists of many varied operations with pipe to form the finished product, it can be seen that the mechanic and his work must have the various functions of the shop close at hand to complete his job efficiently and economically. There are at least two basic plans to resolve shop layout: the process layout and the functional layout. The functional layout, banks of grinders,

lines of drill presses, rows of power saws, etc., is not ideally suited to our needs. The prime disadvantage of this layout is the excessive back-hauling of material in work. Since the production in-line method, i.e., raw material entering one end of the shop and emerging as a finished product at the other end is the concept of our work, the process method is better adapted to our work demands. The principles of mass production however, cannot be applied to our highly specialized work. It must be borne in mind that our type of work requires great flexibility in sequence of fabrication and assembly. This is due to the wide variety of other similar work operations being performed simultaneously. Some conditions particular to shop work require extensive shop operations while other conditions require relatively limited shop operations prior to installation aboard ship. In each operation, effective shop layout should have the necessary equipment arranged in the in-line set up. This would insure maximum efficiency in production. Machines of similar types should be strategically located in the various shop functions so that operational steps in manufacture would move from machine to function and function to machine with minimum effort.

b. Kind of Building

The single-story building, by that I mean the whole shop under one roof and on the ground floor has a number of advantages. They are; ease of handling material, reduced obstructions, machine foundation problems minimized, ease of shop expansion, better natural lighting and ventilation. Again let me emphasize that the product and its method of manufacture determines the ideal layout.

The ideal shop's administration office should have sufficient space for management and its personnel staff. The office should be located where the noises of the shop are at a minimum and still be readily accessible to the production floor. It should have proper ventilation, lighting and the acoustics should be such as to dispel unnecessary noises.

Good administration requires proper management and control of all work progress in the shop. Therefore a conference room capable of seating all supervision of the shop is of prime importance. This room is a necessary part of good administration since it enables top management to meet periodically with supervision and remain abreast of all work progress and problems so inherent to shop work.

c. Receiving and Storage

The best arrangement of the receiving and storage areas in the floor plan of the ideal shop is one which combines

centralization and decentralization and attains the maximum advantages of both. Materials that require special-handling equipment and care in transportation such as thermostatic valves, gauges, carboys of acids, etc., should be moved as little as possible. Storage areas should be located with reference to the receiving areas and the production areas they will serve. Raw materials storage should be centralized and located near the point of use. Supplies and parts may all be provided with centralized storage areas located to reduce handling and delays. The decentralized scheme is particularly desirable when individual storage areas can be made to carry items used only by the respective shop functions served. Whatever storage is used in the shop layout, it should be one that provides an adequate supply of material with a minimum of handling and delay.

The pipe rack areas should be located and so designed as to be readily accessible from the initial stage operations, i.e., bending, fabricating, pickling, etc., and to enable piping being unloaded from trucks to be placed in rack without having truck enter the shop proper. This would eliminate truck exhaust fumes in the shop and help expedite the flow of material from the pipe racks to the production floors. Large size pipes with heavy wall thicknesses are best stored in open racks which provide a decided advantage, since it permits a man to handle even the longest or heaviest sections of pipe without assistance. This would be impractical, unsafe and time consuming if the pipe were in a closed rack. Many changes of pipe design such as larger pipe sizes, metal alloys, etc., are constantly being introduced to the Pipe and Copper trades. Therefore, ample space must be alloted in the pipe rack area for future expansion.

d. Transportation

The ideal shop layout should combine spacious work areas with proper and adequate internal transportation facilities. The shop layout should be so arranged that the work flowing to and from one operation to the next does not interfere with adjoining or adjacent work functions. This can be accomplished by having adequate aisle space sufficient for all internal trucking requirements and the necessary equipment for over-head travel. The entire shop overhead should be criss-crossed with electrically operated hoists and movable trolleys to facilitate handling of all heavy materials. While it is true that short distances make for time saving, the over-head hoists and movable trolleys, covering every square foot of work area, reduces the handling time and worker fatigue to a minimum. The advantage of this means of travel is the ease in which the mechanic is able to handle and move heavy and unwieldy objects to any shop functions without

hindering or interfering with other work. Broad aisles should be clearly defined by painted lines and in no way be blocked by trucks or material waiting for movement to the next shop function. The space immediately surrounding each function must provide for work just finished and for work waiting to be fabricated.

e. Functional Layout

The shop should primarily be built around the bending and fabricating shop functions. These are two of the most important functions in the shop and it is from here that practically every other operational step is ultimately used. These two sections should be immediately adjacent to each other since most frequently one step follows the next. Power saws and grinders should be spotted within each function and also between the functions because piping is frequently cut immediately prior to or after the bending operation. Auxiliary shop functions are other important factors to be considered in the shop layout. It must be remembered that our shop consists of three different trades; pipefitters, coppersmiths and pipecoverer and insulators. In addition, we employ the permanent services of four other trades; Shops 06, 11-26, 31 and 38. Shop 06 for tool issue and maintenance; Shops 11-26 for the all-important chipping and welding; Shop 31 for the machining, facing and boring of flanges, piping sections and jigs; and finally Shop 38 for inspection and repair of large valve bodies and component parts, a vital part of all piping assemblies. Ample areas must be alloted for these allied trades within the shop not merely for present demands but for all future expansion.

Other auxiliary functions to be considered in the layout are the: hanger department; gasket department; acid room; stress relieving section; nipple department; cleaning section; hydrostatic testing section; gas mask department; pipe X-ray section; resin stand; layout tables, floors for mechanical templates; and the vertical and horizontal hydraulic presses. These are but a few of the many auxiliary functions within the shop. Two of these auxiliaries should be given particular attention for space allotment in the floor plan. They are the acid room and the stress relieving section. The acid room should be partitioned off to prevent any acid fumes from entering the shop and should be so located as to be readily accessible to the production floors. Ample space must be alloted between the acid tanks, lye tanks, hot water tanks and neutralizing tanks, etc., to allow for easy handling of bulky objects. The pots capable of handling objects up to twelve feet in length and six feet in diameter should have partitions spaced to accomodate any unusual shaped objects which may have to be hot-dipped. The influx of copper work due to the introduction of atomic energy into the copper field has created

many new problems in its manufacture. To meet this demand, additional space must be planned for future utilization. Special high capacity forced-draft blowers should be installed in the acid room to dispel all acid fumes and vapors and a shower should be installed for emergency purposes. Within the stress relieving section, the Johnston oven should be located in relation to the shop itself rather than to any individual function. Its site is determined by two factors: its tremendous size and the fact that a railroad track is used to load and unload it. This area, when not in use should not be used for any other purpose, such as storage, due to the many delicate gauges, thermostats, gas valves and gas cocks surrounding the oven. Additional ovens should be placed adjacent to or in the immediate vicinity of present ovens to utilize existing piping and cranes. This should be considered in the placement of the original installations.

f. Tools and Toolrooms

Additional space must be alloted in each shop function to allow for storage of workers tool boxes. This is necessary since many shop operations require the use of hand tools which are kept in tool boxes stored in racks. These racks should be placed in such manner as to be easily reached within each work station.

The tool room should be centrally located in the shop to minimize time lost by workers going to and from the tool crib and their work stations. The crib should be maintained with an adequate supply of tools necessary to meet every operation in the shop and have proper tool control of all the tools issued.

g. Personnel Accomodations

Water closets, women's rest rooms and locker rooms should be properly located in reference to the administration office and the production floor. All plumbing fixtures should be adequate to meet the needs of the worker. Again, let me say, that all of these areas should be properly lighted, ventilated and of adequate space.

In planning the ideal shop layout, great consideration should be given to the women worker. In the event of an emergency crisis, the shop's layout should be of sufficient flexibility as to allow for the different demands and requirements of these employees.

A good shop layout is one that retains safe and healthful working conditions for its employees. The layout should be analyzed and checked for safety from every point of view.

The floor plan should be checked for safety at every shop function. Adequate guards and devices should be provided to protect the worker from moving parts, hot pipes, slippery or rough floors and similar hazards. Such processes as metal cleaning and welding operations should be arranged and located with sufficient consideration for the health and fatigue of employees working in these sections as well as of employees in the shop as a whole. Production areas congested with material or equipment are other safety hazards. Therefore, ample space should be provided around each machine for safe operation and material handling.

In the ideal shop, consideration of the quantity of light alone is insufficient. Good illumination reduces eye fatigue thereby increasing production. It also raises the quality of workmanship, reduces accidents and improves employees morale. Good quality of light is attained by the proper direction, diffusion and distribution of light for ease and accuracy of seeing. The quality of light is measured by the absence of such features as glares and shadows. Direct glare and reflected glare can be eliminated by analyzing the sources of glare and then taking corrective action. Good diffusion is attained by scattering the light in all directions through expansion of the size of the light sources. When the human eye must move from one intensity of illumination to another, eye fatigue results. It is therefore readily seen that by providing a uniform distribution of the required quantity of light, the ideal shop will be free of glare and objectionable shadows.

While it is true that heating is often given the first consideration in a shop layout, it is my opinion that ventilation should be considered first, as the amount of ventilation required will materially affect the heating required. Another factor to be considered in the layout is the need of sufficient ventilation to dispel welding and burning fumes, silver-brazing fumes and vapors. Adequate circulation of air and proper control of temperature reduces employee fatigue and accidents.

The layout should incorporate good fire-protection features. Inflammable materials and liquids should be provided for in segregated areas. Fire-fighting equipment must be adequate and properly located. For rapid evacuation of the working force in case of fire, exits must be ample and well located.

2. HOW PRESENT SHOP CONFORMS TO "IDEAL"

a. General Terms

In summing up, if I were asked to name the most important

factor that makes for ideal shop layout, I would unhesitantly state that space and more space is the answer. To serve this space we must of course have the requisite internal transportation. It is with this problem of space that our present shop differs mostly with the ideal concept. We in New York are handicapped to a great extent by the size and shape of the building we now occupy. This building, covering some 120,000 square feet is roughly "L" shaped. Certainly not the most practical layout for our kind of work. In our present shop, we have fully incorporated the theories of in-line production. To overcome to a great extent the space problem, we have built a mezzanine for light manufacturing and storage of gaskets and gas masks. Our administration offices, shop analyst and scheduling, sketching department, men's head and wash room, women's locker and rest room and the supervisor's conference room occupy two floors on one side of the building. These areas are immediately adjoining the production area. The pipecoverer and insulating trade, nipple department and refrigeration department occupy the street floor of a separate building adjoining our main shop. This allows some 10,000 additional square feet for these these activities. Here again the layout conforms to the in-line production set-up. The entire second floor of this building is the men's locker room. Equiped with heads, wash rooms and showers, its facilities are adequate for our present ceiling of 1300 employees.

b. Functional Arrangement

At one end of the pipe shop, close by the receiving door, we have our pipe rack. Here also are located the hanger department, scrap buckets, wet-stone machine and power saws. The Johnston Oven, its length running parallel to the shop, has its receiving doors at this end of the building. Two steel doors give access to the oven enclosure from within the shop proper and from the outside of the building. From this area, going further into the shop, we have on one side of the central aisle; a steel template floor, template layout tables and large Wallace bending machines. On the other side of this aisle are fabricating tables, silver-brazing section, another steel floor and the welding bay. The welding bay, situated along side the fabricating tables is partitioned off from the rest of the shop. The interior walls are painted black to absorb the glaring flashes. Every possible means of ventilation and all safety devices are employed to safeguard the men working here. These shop functions are laid out for maximum efficiency of work sequence and are so arranged as to make full use of every square foot of available space. Within and between these functions are our auxiliary tools, i. e., grinders and power saws. This then, is the heart of our production area. Lathes, boring

mills and radial drill presses are next in line with the fabricating tables. These machines, operated by men assigned from Shop 31, are so arranged in the shop layout scheme that special machining jobs, i.e., jigs and templates, can be done without interruption to the normal flow of fabricated work. Beyond the machine shop work area are the cleaning, testing and inspection department. A good indication of the variety of metal alloys developed and used for naval piping are the testing devices employed in our shop. All main steam propulsion piping, and this includes chrome-molybdenum, carbon molybdenum and carbon-steel is tested with high powered x-ray machines. In addition, other kinds of inspection are made by the metallurgists of Shops 11-26 permanently assigned to our shop. Shop 38 has its own work area in this section for valve inspection. The hydrostatic testing of piping sections is done by our own men.

c. Copper Shop

The Copper Shop is a separate activity within the main building. Coppersmithing, as we all know, is one of the oldest trades and many of its operations are still performed by hand. However, whenever possible, hand and power machines are used to accelerate the work progress. The Copper Shop is for all practical purposes, arranged in such a manner as to efficiently and economically process non-ferrous metal assemblies of sheet and piping. Here again the work sequences are set-up for in-line production but to a lesser degree than the pipe shop since there is a greater amount of artificer hand work involved in the fabrication of non-ferrous assemblies. These are; various size expansion joints, venturi tubes and 42" diameter copper-nickel main injection piping, etc. The shop is laid out in such a way as to have the raw material enter one end of the building, proceed thru the various fabrication steps, enter the acid room for cleaning, on to the hydrostatic test and inspection areas and then routed to the shipping department for delivery.

d. Shipping Department

Well...we finally arrived at the area of organized confusion. The shipping department. To listen to these fellows tell it, we could never assign them enough space, fork-lift trucks or cranes for their needs. One look at the mass of finished work, the product of an average work day, ready to be delivered to the ships, is a darn convincing argument for their side. Our shop has three main shipping doors at one end of the building. Trucks do not back up to a loading platform as they would in the ideal shop, but must back into the shop proper to be loaded. The

space thus occupied by these trucks and trailers even for the comparatively short loading time could be used for trays, pallets and tote boxes waiting to be loaded. The space between the shipping doors is utilized for stacking trays, pallets and tote boxes not in use. Incidentally, these tote boxes were a beneficial suggestion adopted by the Navy Department. They are shipping boxes made of 2" planking which are covered and locked in transit. They are used for shipping valves and smaller fittings which are easily "lost."

3. CONCLUSION

How we have incorporated the ideal shop concept to our present shop layout and scheme of things is indicated by a few facts and figures. During the year 1956 a particularly heavy work schedule year, the New York yard saw the completion of the CVA-60, the early stages of the CVA-62, the conversions of the CVA-12, 18, 20, and the DLG-153 and some twenty six destroyers and destroyer escorts. During this period our shop fabricated and installed over one quarter million feet of pipe, ranging in size from 4" diameter copper and copper-nickel, 16" to 20" corrosion-resistant steel and copper-nickel, 6" to 12" chrome-molybdenum, carbon-molybdenum and carbon-steel piping. This of course was in addition to the more usual standard piping ranging in size down to a half inch. These new high pressure, high temperature piping alloys and unprecedented large size piping fabrications required larger size machines, more space for template layout and new procedures in fabrication. This in turn necessitated the relocation of existing machines and equipment to make place for these additional space demands. This could not have been accomplished had our shop layout been inflexible in its original floor plan. There is always a need for shop layout analysis in our yards. Progressive supervision constantly reviews its facilities for possible improvement. A shop layout that remains unchanged for a number of years can be assumed to be obsolete in some way. This can be understood considering that there are constant changes in the kind and size of piping fabrications demanded by our ever increasingly efficient navy. In closing, let us remember that these efforts are for our great heritage; the resourcefulness, ability and ingenuity of the finest mechanic in the world, the AMERICAN WORKMAN.

Mr. Chamberlain: Thank you, Mr. Ferris; it was a most interesting and enlightening presentation.

Gentlemen, we will have to make a slight change on the agenda. Mr. Richards of the Puget Sound Naval Shipyard was to have talked to us before luncheon on "Pipe Fabricating Techniques in Industry," but time is running out. It is now 1102, and we are due at the Officers' Club promptly at 1130. We will adjourn and hear Mr. Richards at 1245.

Thank you.

Mr. Chamberlain: And now we will hear from Mr. Richards of the Puget Sound Naval Shipyard, who will present a paper on the "Pipe Fabricating Techniques in Industry." Mr. Richards.....

"Pipe Insulation Processes and Procedures"

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Mr. O. W. Meeker
Long Beach Naval Shipyard

"Pipe Insulation Processes and Procedures"

Gentlemen:

We, Master Pipefitters, more than any other group of people, face the increasingly important and difficult task of providing and installing effective insulating materials aboard Naval Vessels.

Why is this an important and difficult task?

What are we doing about it?

What advances have been made?

What does the future hold?

The manner in which insulating materials is applied, and also the selection of these materials, affects both habitability and operating efficiency of our ships. An otherwise perfectly designed ship would be of little value if heat from steam pipes and machinery was allowed to escape and convert the ship into an immense oven which could bake the crew. We gain little by constructing boilers, reactors and heat exchangers to squeeze the maximum BTU of power from the available fuel and then permitting heat to escape from the system before it expends its energy on the rotor of the turbine.

Comfort of the crew is not a luxury. In order that men arrive at their battle positions in good health, capable of performing with maximum effectiveness, this comfort must be maintained by whatever control we can exercise over living conditions.

The steam turbine is a heat engine. Every conceivable device is built into the boiler to obtain the best possible combustion and to transfer the greatest amount of heat to the water in order to generate the maximum amount of steam per pound of fuel consumed. The steam is then superheated to an even higher temperature to enable it to deliver even greater quantities of heat energy to the rotor of the turbine.

If the boiler steam drum, the valves and piping, the turbines and pumps are not properly insulated, much of the heat energy will be lost to the atmosphere, raising temperatures in the machinery spaces to the point where they become unbearable. This unwanted heat must be removed by large, powerful and expensive ventilation systems. As the blower supplies and the exhauster removes air, wind is generated. As the wind velocity increases,